U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-268 248

Oil Spill and Oil Pollution Reports November 1976 - January 1977

California Univ, Santa Barbara Marine Science Inst

Prepared for

Industrial Environmental Research Lab Cincinnati, Ohio

Apr 77

PB 268 248

EPA-600/2-77-075
April 1977

Environmental Protection Technology Series

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/2-77-078
April 1977

OIL SPILL AND OIL POLLUTION REPORTS

November 1976 - January 1977

by

Penelope Melvin, Helmut Ehrenspeck, and Paul Nordin
Marine Science Institute
University of California
Santa Barbara, California 93106

Grant No. R803992

Project Officer

J. S. Dorrler
Oil & Hazardous Materials Spills Branch
Industrial Enviromental Research Laboratory-Cincinnati
Edison, New Jersey 08817

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

ia

DISCLAIMER

This report has been reviewed by the Industrial Environmental Research Laboratory-Cincinnati, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report is a product of the above efforts. It cites current events, literature, research, patents, and other material relevant to the oil pollution abatement program and is published in an abstract format on a quarterly basis. As such, it serves as a basic reference document for all those interested in oil spill and oil pollution control. This project is part of the continuing program of the Oil & Hazardous Materials Spills Branch, IERL-Ci to assess and mitigate the environmental impact of oil pollution.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

ABSTRACT

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin designed to review current scientific and technical publications and research projects in the field of oil pollution. Subject coverage includes all aspects of aquatic and terrestrial oil pollution. This issue contains summaries of research projects and published information selected from the scientific and technical literature during the period November, 1976 through January, 1977

The following sections are included in the report:

I. Reports, Publications, and Patents
II. Current Research Projects
III. Current Oil-Related Conferences

This report is submitted in partial fulfillment of EPA Grant No. R803992-01 by the Marine Science Institute, University of California, Santa Barbara, California, under the sponsorship of the Environmental Protection Agency.

CONTENTS

Page

Abstract iv

Acknowledgements viii

Introduction ix

Sections

I. Reports, Publications and Patents

A. Oil Pollution Detection and Evaluation

1. Reporting 1

2. Monitoring 10

3. Remote Sensing 18

4. Sampling 25

5. Analysis 27

6. Source Identification 34

B. Oil Pollution Prevention and Control

1. Containment 37

2. Cleanup and Recovery 39

3. Oil Transfer and Transport. 51

4. Waste Treatment and Disposal Methods. 56

5. Reclamation and Reuse 83

6. Personnel Training and Education 89

7. Contingency Planning 90

8. Prevention and Control Measures 92

C. Effects of Oil Pollution **Page**

1. Biological Effects 101
2. Economic Effects 119
3. General Effects 120

D. Effects of Oil Exploration and Production

1. Biological Effects 126
2. Social Effects 129
3. Chemical Effects 130
4. Economic Effects 131
5. General Effects. 134

E. Fate of Oil in the Environment

1. Biodegradation 146
2. Physical Changes 152
3. Chemical Changes 154
4. General Fate of Oil 156

F. Oil Pollution Regulations

1. State Legislation. 164
2. U.S. Legislation 165
3. International Legislation. 167
4. Foreign Legislation. 168
5. Agreements and Conventions 169
6. Standards and Guidelines 172
G. Bibliographies 174

Page

II. Current Research Projects 178

A. Oil Pollution Detection and Evaluation

1. Monitoring 179
2. Remote Sensing 184
3. Analysis 186

B. Oil Pollution Prevention and Control

1. Cleanup and Recovery 188
2. Restoration 190
3. Waste Treatment and Disposal Methods 192
4. Prevention and Control Measurus. 196

C. Effects of Oil Pollution

1. Biological Effects 198
2. Economic Effects. 212
3 General Effects 213

D. Fate of Oil in the Marine Environment

1. Biodegradation 215
2. General Fate of Oil. 217

III. Current Conferences. 220
Master List of Keywords 243
Subject Index 248
Author Index 286
Appendix 291

ACKNOWLEDGEMENTS

The authors express their gratitude to Ms. Kathy Courtney for typing the camera-ready copy of Oil Spill and Oil Pollution Reports. We also wish to thank the personnel of the Science-Engineering Library, University of California, Santa Barbara, for their professional assistance during the research stages of the project, and Mr. Bruce Harger for his efforts in developing the computer program for the Subject Index.

INTRODUCTION

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin which reviews pertinent scientific and technical publications and research projects to provide its readers with current developments in the field of oil pollution. This issue contains summaries of articles, reports, patents, documents, and other materials relating to oil pollution published during the period 1974 to 1976 (Section I); summaries and status of current research projects (Section II); and current oil-related conferences (Section III).

Subjects covered include all aspects of aquatic and terrestrial oil pollution. Items in Section I are categorized by seven major subdivisions which are divided into thirty-two specific subject categories. These are presented in the Table of Contents. Patents and patent applications are announced under appropriate subject categories. Subject and author indexes for entries in Section I are provided at the end of the report. A list of the periodicals reviewed in preparing this series appears in the Appendix.

Section II presents titles of active or recently completed oil pollution research projects, summaries of project objectives, and current status information and/or resulting publications provided upon request by the principal investigators or performing organization. Notices of research projects were obtained from the Smithsonian Science Information Exchange (SSIE); American Society for Microbiology, Aquatic Microbiology Newsletter; and Canada, Department of the Environment, Spill Technology Newsletter. Entries are arranged according to the same subject categories as in Section I and are ordered by serial number within each subject division. Some of the current projects listed in previous Oil Pollution Reports have been recently renewed. These projects have been relisted and headed by the same serial number as originally reported, followed by the word (renewal). Renewal entries are listed at the beginning of each subject category.

Section III, Current Oil-Related Conferences, contains descriptive information on recently held and upcoming conferences relevant to any aspects of oil pollution. Conference dates are listed, and, when information is available, titles, authors, and abstracts of conference papers are included. All information for this section was obtained from the periodicals reviewed (Appendix) and from responses to written inquiries concerning the meetings.

Entries in Section I and II have separate serial numbers. The letters preceding the serial numbers designate the following: C, reports, publications, and patents; and R, research projects.

SECTION I. REPORTS, PUBLICATIONS, AND PATENTS

A. OIL POLLUTION DETECTION AND EVALUATION

1. REPORTING

C-0001-77
No title given (news brief)
Anon. 1976.
Chemical and Engineering News 54(46):20.

Oil spills, Beaches, Metula oil spill, Tankers, Strait of Magellan

Dr. Roy Hann Jr., director of Texas A & M's Center for Marine Resources, reports that the Strait of Magellan will be fouled by oil for more than a decade due to the supertanker Metula which spilled 48,600 metric tons (54,000 tons) of oil there in 1974. In some places the oil has penetrated up to 18 cm (7 inches) of beach sand, producing a pavement-like surface on the beach.

C-0002-77
ATLANTIC COAST DRILLING SET (news brief)
Anon. 1976.
Environmental Action 8(8):6.

Offshore drilling, OCS, Atlantic coast, Environmental effects, Socio-economic effects

In August, 1976, oil companies collectively bid $1.5 billion for oil and gas leases on federally owned, outer sea-shelf areas of the Baltimore Canyon Trough region. The 154 tracts offered cover an area of about 355,000 hectares (876,000 acres) and are from 80 to 145 km offshore. Environmentalists are concerned not only about possible oil spills but also about the economic and social impact of the massive drilling projects on coastal communities.

C-0003-77
FILTH FROM THE SEA (news brief)
Anon. 1976.
Environment 18(7):21.

Contamination, Waste oil, *Sewage, Beaches, New York

In what seemed to be a protest by the environment, garbage, sewage, oil and oily waste and other detritus began washing up on New York beaches as the height of the Bicentennial celebration approached, in mid to late June, 1976. The news brief reports on this event, its possible sources, and reaction by the public and government personnel to the spreading blight.

C-0004-77
LARGE OIL SPILLS (news brief)
Anon. 1976.
Environment 18(7):22.

Oil spills, Tankers, *Supertanker accidents

The news brief reviews recent supertanker accidents which have accounted for a tonnage loss of 815,000 tons in the first four and one-half months of 1976 alone. The resultant oil spills are briefly covered.

C-0005-77
MID-VALLEY PIPELINE COMPANY CRUDE OIL TERMINAL FIRE NEAR LIMA, OHIO, JANUARY 17, 1975
Anon. 1976.
Pipeline accident report, NTSB-PAR-76-3. 24 p.

Pipelines, Crude oil, *Oil terminal fire, Ohio

The accident was believed to be caused by the inadvertent closing of a 12-inch, motor-operated valve against the crude oil stream and the subsequent buildup of pressure until a substandard flange in a low-pressure meter manifold ruptured. The crude oil which sprayed from the crack probably was ignited when a truck in the meter building was started.

[from Government Reports Announcements 76(18): PB-253 998/ OGA. 1976]

C-0006-77
MORE OIL (news brief)
Anon. 1976
Environment 18(7):22-23.

Oil spills, Inland, Crude oil, Fuel oil, U.S., Canada

The news brief reviews the occurrence of five major inland oil spills from April to June, 1976, as reported by the Center for Short-lived Phenomena. Well over 110 million liters (over 21 million gallons) of crude oil and fuel oil were spilled in these separate incidents which occurred in Ohio, Tennessee, Texas, New Jersey, and in the St. Lawrence Seaway.

C-0007-77
OIL BARGE SINKS IN CHESAPEAKE BAY (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(9):163.

Oil spills, Fuel oil, Chesapeake Bay, Beaches, Birds, Marine organisms, *Oil barge

A barge filled with Bunker C fuel oil sank in 33 m of water in lower Chesapeake Bay, spilling over 950,000 liters (250,000 gal) of oil and polluting 150 km of beaches. Ten thousand birds were affected and 32 km of commercial shellfish beds were contaminated.

C-0008-77
OIL SLICK IN THE CLYDE (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(10):180.

Oil slicks, Estuaries, United Kingdom, Birds, Source identification, Bilges

An oil slick about 1.6 km (1 mile) in length has reached the shore at Maidens and Dunure in the Clyde Estuary. Tar lump samples were sent to the Purification Board laboratories for analysis and possible identification. Several seabirds were killed by the oil which was probably discharged bilge water from a ship.

C-0009-77
OIL SPILL IDENTIFICATION (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(10):179.

Oil spills, Source identification, Tankers, Florida, *U.S. Coast Guard

As a result of the discharge of several thousand gallons of oil into the sea off Key West, Florida in 1975, the U.S. Coast Guard inspected 250 vessles known to be in the area at that time. Fifty oil samples were taken for comparative analysis with the dumped oil. The only ship whose samples matched those from the site of the spill was the Liberian tanker, "Garbis". The owners, an English shipping company, now face possible fines.

C-0010-77
PREVENTION OF OIL POLLUTION (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(8):142.

Oil spills, United Kingdom, Crude Oil, *Fines

The United Kingdom's Department of Trade imposed £81,380 of fines due to oil pollution in 1975. Fifty-six prosecutions were undertaken out of 1731 inspections of various vessels and all were successful. The most serious case involved the spillage of 2250 metric tons (2500 tons) of crude oil from the tanker, "Olympic Alliance".

C-0011-77
SPILLS NEWSLETTER AVAILABLE (news brief)
Anon. 1976.
Chemistry in Canada 28(8):18.

Oil spills, Pollution prevention, Information systems, *Spills Newsletter

"Spill Technology Newsletter is a mimeographed newsletter published bi-monthly by the Environmental Emergency Branch, Environmental Protection Service, Ottawa, Ontario K1A 0H3. Editorial contents emphasize oil spill research and control technology activities."

C-0012-77
TRANSFRONTIER POLLUTION: TOWARDS A COMMON APPROACH
Anon. 1976.
The Science of the Total Environment 6(2):184-193.

Contamination, Mediterranean Sea, Hydrocarbons, Oil discharges, Tankers, Refineries

A recent study was commissioned by OECD's Environment Committee to investigate the adverse effects resulting from pollution of coastal waters of the Mediterranean Sea. The study concludes that pollution of the Mediterranean by hydrocarbons is by far the most pervasive problem. The quantity of hydrocarbons discharged into the sea every year is estimated at 300,000 tons from oil tankers using free zones of discharge, and 20,000 tons from refineries. This estimate does not include other sources such as loading and unloading of tankers, accidental spillages, and offshore drilling.

C-0013-77
UPDATING THE NAVY ENVIRONMENTAL PROTECTION DATA BASE TO INCORPORATE OIL SPILL CLEANUP PERFORMANCE
Antonelli, J. 1975.
Thesis, Naval Postgraduate School, Monterey, California. NTIS #AD-A012 863. 70 p.

Oil spills, Cleanup, Information systems, Environmental protection, Contingency planning, Economics, *Data base, *Navy

Methods for reporting, collecting, and disseminating information about oil spills to and from the Navy Environmental Protection Data Base are proposed. The reporting aspect consists of a contingency plan, an initial report and a post-action report. Data collection emphasizes information which will yield accurate cost figures. New report formats will be included in quarterly summary reports to improve the dissemination.

[from Selected Water Resources Abstracts 9(16):#W76-08320. 1976]

C-0014-77
POLYCYCLIC AROMATIC HYDROCARBONS AND FOODS
Barnett, D. 1976.
C.S.I.R.O. Food Research Quarterly (36):8-12.

PAH, Contamination, *Foods, Health hazards, Carcinogens

"A review with 21 references of the occurrence of polycyclic aromatic hydrocarbons in foods, the sources of contamination, and the potential health hazards."

[from Chemical Abstracts 85(13): #92239r. 1976]

C-0015-77
CANADIAN OIL AND HAZARDOUS MATERIAL SPILLS IN 1974 AND 1975
Beach, R.A., and K.M. Meikle. 1976.
Spill Technology Newsletter 1(3):23-28.

Oil spills, Information systems, Canada

A number of tables are presented which summarize oil and hazardous materials spills in Canada for 1974-1975. About 900 events annually are recorded in a computerized databank known as NATES (National Analysis of Trends in Emergencies Systems) which was established in 1972. The spill information is listed by source, cause, amount spilled, and type of incident. Addresses are provided for persons having spill information to report.

C-0016-77
FURTHER DEVELOPMENTS OVER OIL POLLUTION OF THE SANDS OF FORVIE (news brief)
Bourne, W.R.P. 1976.
Marine Pollution Bulletin 7(9):164.

Oil spills, Fuel oil, Environmental effects, Birds, Scotland, *Sands of Forvie

An investigation into the grounding of the "Minto" and the resulting diesel oil spill off the Sands of Forvie National Nature Reserve in Aberdeenshire, Scotland, revealed many inconsistencies in the reporting of the environmental effects of the oil spill. This was especially noticeable in the area of Eider and seabird deaths.

C-0017-77
SYMPOSIUM WEIGHS EFFECTS OF OIL POLLUTION
Leeper, E.M. 1976.
Bioscience 26(10):601-604.

Hydrocarbons, Biological effects, Fate, Environmental effects, *Symposium

A symposium is reviewed entitled, "Sources, Effects, and Sinks of Hydrocarbons in the Aquatic Environment", held at American University, Washington, D.C., August 9-11, 1976. Emphasized are the environmental and biological effects of hydrocarbons. FFI contact Patricia Russell, Special Science Programs Dept., AIBS, 1401 Wilson Blvd., Arlington, VA 22209.

C-0018-77
BURNING WATERS
Markow, H.L. 1976.
The Florida Bar Journal 50(1):20-23.

Oil spills, Inland, Pollution prevention, Legislation, Liability, Contingency planning, *Reporting requirements

Means to reduce the danger of inland waters burning from the presence of oil pollutants are covered. Increasingly strict federal and state legislation regarding oil spillage and liability assessment, and constant surveillance and preparedness by U.S. Coast Guard National Strike Force teams are helping to reduce the problem. Strictly enforced spill reporting requirements and prompt private reporting of spills are considered the best means of preventing oil spills from becoming holocausts.

[from Selected Water Resources Abstracts 9(20): #W76-10741. 1976]

C-0019-77
USSR MOVES TO CONTROL POLLUTION
Micol, C.W. 1976.
Oilweek 27(35):18-19.

Oil spills, Pollution control, USSR, Cleanup, Booms, Skimmers, Dispersants

The Soviet Union's approach to oil spills and oil pollution since new water legislation was put into force by the Supreme Soviet in 1971 is reviewed. Booms, skimmers, dispersants, and polyurethane foam are used depending on slick size and thickness; oil spill incidents have been significantly reduced.

[from Petroleum Abstracts 16(47): #227,232. 1976]

C-0020-77
THE URQUIOLA OIL SPILL - LA CORUNA, SPAIN
Robertson, I., J.R. McDonald, N.S. Robertson, and L.R. Solsberg. 1976.
Spill Technology Newsletter 1(3):5-8.

Oil spills, Tankers, Cleanup, Dispersants, Acute effects, Marine organisms, Spain, *Urquiola oil spill

The Urquiola oil spill incident, which began with a tanker grounding and subsequent explosion on May 12, 1976, is described. The containment, dispersal, and cleanup efforts by government agencies and private contractors are reviewed. The acute biological effects of the oil and the dispersant upon marine and shore life, especially the shellfish resources, are noted.

C-0021-77
IS OUR APPROACH TO THE OIL POLLUTION PROBLEM TOO CRUDE?
Sullivan, J.B. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2., p. 809-824.

Oil transport, Crude oil, Petroleum products, Oil discharges, Oceans, Carcinogens

Presented are some preliminary notes dealing with quantities of crude oil and product shipped, quantities discharged into the ocean, and a short literature review of the carcinogenic content of crudes and of refined products.

[from Selected Water Resources Abstracts 9(20): #W76-11031, 1976]

C-0022-77
REPORT BY THE DEPARTMENT OF TRADE ON THE ACTION TAKEN TO DEAL WITH THE OIL SPILLED AS A RESULT OF THE COLLISION IN THE DOVER STRAIT ON 12 NOVEMBER 1975 BETWEEN THE M/T OLYMPIC ALLIANCE AND HMS ACHILLES
United Kingdom Department of Trade. 1976.
London, United Kingdom Department of Trade, 1976. 21 p.

Oil spills, Crude oil, Cleanup, United Kingdom, *Dover Strait

The land-based operations and counter measures taken at sea to clean up 1800 metric tons (2000 tons) of spilled crude oil in the Dover Strait are described. The national anti-oil pollution organization and the available facilities are summarized.

[from Aquatic Sciences and Fisheries Abstracts 6(10): #6Q11114, 1976]

C-0023-77

THE SITUATION IN JAPAN

Yamaguchi, T. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 20 p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Oil spills, Contamination, Japan, Biological effects, Legislation, Pollution prevention

The amount of oil pollution, number of oil spill incidents, and the degree of pollution from pelagic oil balls monitored from 1969-1974 in and around Japan are tabulated. A spill incident caused by the failure of a refinery storage tank is reviewed, with emphasis on the acute and chronic biological effects of the spill. Existing and proposed Japanese legislation to prevent or mitigate marine oil pollution is reviewed, and spill prevention techniques presently under development are briefly outlined.

2. MONITORING

C-0024-77
No title given (news brief)
Anon. 1976.
Chemical and Engineering News 54(47):25.

Monitoring, Hydrocarbons, Bilges, Ballast, Design and engineering, *Fluorescence, *Oil-in-water

Baird-Atomic has developed a prototype oil-in-water content monitor suitable for use in monitoring shipboard bilge and ballast water. The unit measures the fluorescence of aromatic molecules in the oil to determine concentration and will incorporate a total luminescence technique for accurately measuring any oil or mixture of oils without recalibration.

C-0025-77
BASELINE INVESTIGATION OF ECOLOGICAL CONDITIONS ADJACENT TO THE SITE OF THE TABLAZO PETROCHEMICAL COMPLEX IN PUERTO MIRANDA, VENEZUELA
Bean, R.M. 1976.
Technical report, Battelle-Northwest Laboratories.

Monitoring, Refineries, Petrochemicals, Venezuela, Environmental effects, *Baseline studies

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655, p. 7]

C-0026-77
THE OCCURRENCE AND AMOUNT OF PELAGIC TAR IN THE OPEN OCEAN
Butler, J.N. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol.2. p. 375-399.

Monitoring, Tar, Oceans, Detection, Distribution

Quantitative measurements of pelagic tar lumps on the open ocean have been made since 1969 with amounts varying from less than 0.1 mg/m^2 to over 500 mg/m^2, depending upon location. Concentrations in the Mediterranean, the Canary Current, the North Equatorial Current, and the Sargasso Sea appear to be higher by more than a factor of ten than tar concentrations in the Caribbean, Gulf of Mexico, and coastal North America.

[from Selected Water Resources Abstracts 9(20): #76-11008. 1976]

C-0027-77
METHODS FOR DETERMINATION OF SOME SELECTED ORGANIC PARAMETERS IN WATER
Carlberg, J.R., and P. Solyom. 1975.
FAO Fisheries technical paper, FIRI/T137. p. 169-192.

Monitoring, Sampling, Hydrocarbons, Storage

Methods are described for the determination of the MnO_4-value of organic matter in natural waters, BOD in wastewaters, suspended matter content, and small amounts of nonpolar hydrocarbons (mineral oil) in waters. Sampling techniques and storage requirements are discussed.

[from Chemical Abstracts 85(12): #83059e. 1976]

C-0028-77
MARINE POLLUTION MONITORING (PETROLEUM)
Butler, J.N., et al. 1974.
World Meteorological Organization/Intergovernmental Oceanographic Commission/U.S. Department of Commerce Symposium, 1974. 333 p.

Monitoring, Sampling, Oil slicks, Tar, Analytical techniques, Sediments, Marine organisms, Seawater

The proceedings of a conference on monitoring of oil pollution include presentations on sampling and sampling methods for oil slicks, tar balls and particulates; sampling and analytical methods for oil in water, marine organisms, and sediments.

[from Environment Abstracts 6(7/8): #76-05079. 1976]

C-0029-77
HYDROCARBON CONTENT IN NEW JERSEY BEACH SANDS, 1973
Dorfman, D., L.W. Littau, T.M. Piecara, J.R. Trout, and D. Dorfman. 1975.
Bulletin, New Jersey Academy of Sciences 20(1):14-17.

Monitoring, Hydrocarbons, Beaches, New Jersey

A trend of decreasing hydrocarbons was found with significant differences between areas in a north-to-south gradient. Solvent washings removed ~91% of the total hydrocarbon fraction present. No differences were found in hydrocarbon removals obtained above, at, or below the high-tide line.

[from Chemical Abstracts 85(12): #81230e. 1976]

C-0030-77
HYDROCARBONS IN BLUE MUSSELS FROM THE KIEL BIGHT
Erhardt, M., and J. Heinemann. 1974.
Marine Pollution Monitoring (Petroleum), Proceedings, 1974.
NBS Special Publication 409. p. 221-225.

Monitoring, Hydrocarbons, Detection, Mollusks, *Blue mussel, *Kiel Bight

Hydrocarbons in concentrations slightly above the natural background of recent biogenic hydrocarbons were found in the blue mussel, *Mytilus edulis*, from a location in the Kiel Bight. The biogenic hydrocarbon level was higher in mussels collected after the spring phytoplankton bloom than in mussels collected in January. Concentrations of cycloalkanes, aromatic hydrocarbons, and mixed types of fossil origin also had a tendency to rise.

[from Selected Water Resources Abstracts 9(19): #W76-10408. 1976]

C-0031-77
IMPROVEMENT OF AN OIL-WATER POLLUTION MONITORING SYSTEM
Gongaware, W.R. 1976.
Master's Thesis, Naval Postgraduate School, Monterey,California. 98 p.

Monitoring, *Oil pollution, Design and engineering

The improved system utilizes a direct difference method of total organic carbon determination. The improvements permit a rapid evaluation of organic carbon content of test samples. This research was aimed at determining standards for the type of fluids expected to transport oil into the monitoring systems.

[from Government Reports Announcements 76(20): #AD-A027 237/7GA. 1976]

C-0032-77
IDENTIFICATION, ESTIMATION AND MONITORING OF PETROLEUM IN MARINE WATERS BY LUMINESCENCE METHODS
Hornig, A.W. 1974.
Marine Pollution Monitoring (Petroleum), Proceedings, 1974. NBS Special Publication 409. p. 135-144.

Monitoring, Analytical techniques, Source identification, Oil spills, *Luminescence methods

When the concentration of residual oils in seawater is less than 10 ppb, fluorescence analysis is superior to the absorbance method due to its sensitivity and low interference level. Luminescence also offers a specific and sensitive method for the study of oil in water.

[from Selected Water Resources Abstracts 9(19): #W76-10395. 1976]

C-0033-77
A SHIPBOARD OIL-IN-WATER CONTENT MONITOR BASED ON OIL FLUORESCENCE
Hornig, A.W., J.T. Brownrigg, B.R. Chisholm, and L.P. Giering. 1976.
Final report, USCG-D-54-76; Contract DOT-CG-34169. 205 p.

Monitoring, Detection, *Oil-in-water, Ships, Design and engineering

The improved Oil-in-Water Content Monitor uses dual polychromators to present a total luminescence image. The monitor produces a real time output which is linear in oil concentration and which can be calibrated directly in ppm. Results of the laboratory test program are fully documented, potential problems are discussed, and recommendations for further improvements are given.

[from Government Reports Announcements 76(20): #AD-A027 262/5GA. 1976]

C-0034-77
SHIPBOARD OIL IN WATER MONITOR
Nucor Corp. 1974.
Contract N00024-74-C-5444. 23 p.

Monitoring, Detection, *Oil-in-water, Ships, *Flame spectroscopy

The feasibility of the flame emission technique for the monitoring of oil in water samples was determined. This technique is useful for the detection of high vapor pressure oils; however, the lower vapor pressure oils were not detected reliably.

[From Government Reports Announcements 76(20): #AD-A027 636/8GA. 1976]

C-0035-77
BASELINE CONCENTRATIONS OF HYDROCARBONS IN BARRIER - ISLAND QUARTZ SAND, NORTHEASTERN GULF OF MEXICO
Palacas, J.G., P.M. Gerrild, A.H. Love, and A.A. Roberts. 1976.
Geology 4(2):81-84.

Monitoring, Hydrocarbons, Beaches, Gulf of Mexico, Chemical analysis

Baseline information from which petroleum pollution is measurable is provided by determinations of the amount and molecular distribution of indigenous hydrocarbons in coastal sand. Marine, lagoon, and pond facies of the barrier-island sand were characterized by organic C, alkanes, total hydrocarbons, alkane/organic C and hydrocarbon/organic C ratios and gas chromatographical analyses. No evidence of petroleum pollution was found.

[From Chemical Abstracts 85(12): #81234j. 1976]

C-0036-77
PROCEEDINGS OF CONFERENCE ON ENVIRONMENTAL QUALITY SENSORS (SECOND) HELD AT NATIONAL ENVIRONMENTAL RESEARCH CENTER, LAS VEGAS, NEVADA, OCTOBER 10-11, 1973.
U.S. Environmental Protection Agency. 1973.
Environmental Protection Agency report. 786 p.

Monitoring, Remote Sensing, Contaminants, Petroleum products, Water quality, *Air quality

The following technical sessions were discussed: National Environmental Research Center-Las Vegas programs; National Aeronautics and Space Administration-Langley Research Center sensor programs; air quality sensor developments; water quality sensor development; environmental thematic mapping, oil and hazardous material sensors; satellite environmental monitoring applications; environmeatal monitoring applications.

[from Government Reports Announcements 76(19): #PB-254 570/5GA. 1976]

C-0037-77
PHYSICAL AND CHEMICAL OCEANOGRAPHIC CHARACTERIZATION OF THE CHERRY POINT SITE AND VICINITY. VOLUME I
Vanderhorst, J.R., and P. Wilkinson. 1974
Final report to Atlantic Richfield Co., Cherry Point Refinery, Ferndale, Washington.

Monitoring, Refineries, Washington, *Physical and chemical characterization, Oceans, *Cherry Point Refinery

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655. p. 130]

C-0038-77
FIELD AND LABORATORY STUDIES TO OBTAIN A COMPARATIVE BASELINE FOR ASSESSING THE IMPACT OF REFINERY DISCHARGE AND POTENTIAL OIL SPILLAGE ON THE CHERRY POINT ENVIRONS. VOL. II. BASELINE STUDIES
Vanderhorst, J.R., P. Wilkinson. 1974.
Final report to Atlantic Richfield Co., Cherry Point Refinery, Ferndale, Washington.

Monitoring, *Baseline studies, Environmental effects, Oil discharges, Refineries, Oil spills, Washington, Cherry Point refinery

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655. p. 130]

C-0039-77
FIELD AND LABORATORY STUDIES TO OBTAIN A COMPARATIVE BASELINE FOR ASSESSING THE IMPACT OF REFINERY DISCHARGE AND POTENTIAL OIL SPILLAGE ON THE CHERRY POINT ENVIRONS. VOL. III. REFINERY IMPACT EVALUATIONS
Vanderhorst, J.R., P. Wilkinson, C.W. Apts, and S.L. Kiesser. 1974.
Final report to Atlantic Richfield Co., Cherry Point Refinery, Ferndale, Washington.

Monitoring, *Baseline studies, Environmental effects, Oil discharges, Refineries, Oil spills, Washington, *Cherry Point refinery

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655, p. 130]

C-0040-77
FIELD AND LABORATORY STUDIES TO OBTAIN A COMPARATIVE BASELINE FOR ASSESSING THE IMPACT OF REFINERY DISCHARGE AND POTENTIAL OIL SPILLAGE ON THE CHERRY POINT ENVIRONS. VOL. IV. BIOASSAY STUDIES
Vanderhorst, J.R., P. Wilkinson, and S.L. Kiesser. 1974.
Final report to Atlantic Richfield Co., Cherry Point Refinery, Ferndale, Washington.

Monitoring, *Baseline studies, Environmental effects, Oil discharges, Refineries, Oil spills, Washington, *Cherry Point refinery

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655, p. 130]

C-0041-77
COLONIAL AUKS AND EIDERS AS POTENTIAL INDICATORS OF OIL POLLUTION
Vermeer, K. 1976.
Marine Pollution Bulletin 7(9):165-167.

Monitoring, Contamination, Birds, Oil spills, Coasts, Canada

The monitoring of colonial auk populations in eastern Canada can be used as an indicator of the effects of oil pollution on the seabirds of Canada's coastal zones. In the western Arctic common eiders may serve as the best indicators of oil pollution, as auk populations are scarce.

C-0042-77
PELAGIC TAR IN THE NORTH PACIFIC OCEAN
Wong, C.S., D.R. Green, and W.J. Cretney. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p. 400-415.

Monitoring, Tar, Oceans, Pacific Ocean, Distribution

Tar lump concentration monitoring by means of a net tow would be a convenient method of monitoring the level of oil pollution in the world's oceans. Data on the standing stock of tar balls and their annual and seasonal variation could be ascertained in a short time.

[from Selected Water Resources Abstracts 9(20): #W76-11009. 1976]

C-0043-77
THE BALTIC SEA POLLUTION
Zmudzinski, L. 1975.
Polskie Archiwum Hydrobiologii 22(4):601-614.

Monitoring, Hydrocarbons, Baltic Sea, Crustaceans, Fishes, Biodegradation, Bacteria

In studies of hydrocarbon contamination of the Baltic Sea from 1971 to 1973, some crustacean species were found to be bioindicators of hydrocarbons, while benthic fishes were not sensitive to hydrocarbons. Flavobacterium bacteria showed the highest biodegradation activity which decreased with decreasing temperature and increasing hydrocarbon concentration.

[from Biological Abstracts 62(11): #63304. 1976]

3. REMOTE SENSING

C-0044-77
REMOTE SENSING AS A MONITORING TOOL
Anon. 1976.
Environmental Science and Technology 10(10):972-973.

Remote sensing, Oil spills, Environmental protection, Pollution control

Actions taken by the Remote Sensing Division of the Environmental Monitoring and Support Laboratory, EPA, to monitor an oil spill in the Mississippi River in March, 1975, are reviewed as an example of how aerial photographs are used for the surveillance of environmental threats. Other applications of remote sensing are given and research and development in the field are discussed.

C-0045-77
REMOTE SENSING OF OIL SLICKS. RESULTS FROM A FIELD EXPERIMENT IN THE BALTIC SEA, SEPTEMBER 1974
Axelsson, S. 1975.
Saab-Scania AB, Linköping, Sweden, Report RL-0-3-R27. 78 p.

Remote sensing, Oil spills, Baltic Sea, *Multisensor technique

Various remote sensing techniques were used to map different types of oil spills at sea in order to compare equipment sensitivity. The use of multisensor technique was found to be necessary in order to accurately map oil spills. Further studies of the false alarm risk are recommended.

[from Aquatic Sciences and Fisheries Abstracts 6(4): #6Q4271. 1976]

C-0046-77
REMOTE SENSING OF OIL POLLUTION WITH IR AND MICROWAVE RADIOMETRY. RESULTS FROM A FIELD EXPERIMENT
Axelsson, S., and K. Kaski. 1974.
Saab-Scania AB, Linköping Sweden. Report RL-0-3-R265. 36 p.

Remote sensing, Oil Slicks, Spreading, Analytical techniques, *Microwave radiometry, *IR radiometry

The capabilities of airborne microwave and thermal IR radiometry for estimating the extent and volumes of oil slicks were field tested and compared. Most of the visible areas of the slick were not detected by IR radiometry, indicating an oil film thickness less than 0.5 μ. Microwave radiometry was found to be useful in estimating volumes of thick oil films. Repeated coverage at different wavelength bands (ultraviolet to infrared) yields data useful for pointing out the thickest slick areas and for estimating volumes.

[from Aquatic Sciences and Fisheries Abstracts 6(7): #6Q7631. 1976]

C-0047-77
APPLICATIONS OF REMOTE SENSING TECHNOLOGY TO ENVIRONMENTAL PROBLEMS OF DELAWARE AND DELAWARE BAY
Bartlett, D., V. Klemas, W. Philpot, and R. Rogers. 1975.
NASA Earth Resources Survey Symposium, 1975. Vol 2-B.
Special Session Presentations. Coastal Zone Management, State and Local Users, User Services. p. 186-194.

Remote sensing, Oil slicks, Models, Movement, Delaware Bay

"Digital processing of multispectral LANDSAT data was used to develop a computerized model for predicting oil slick movement within the Delaware Bay. LANDSAT imagery was also used to monitor offshore waste disposal sites for mapping of wetlands, and charting of tidal currents."

[from Scientific and Technical Aerospace Reports 14(17): #N76-26649. 1976]

C-0048-77
EVALUATION OF A PASSIVE MICROWAVE TECHNIQUE FOR THE MEASUREMENT OF OIL FILM THICKNESS IN A TEST TANK ENVIRONMENT
Hollinger, J.P., and J.E. Kenney. 1976.
Report no. NRL-MR-3308. 57 p.

Remote sensing, Oil slicks, Containment, Cleanup, *Performance tests, *Microwave equipment

The performance testing and evaluation of various oil containment and cleanup devices require an accurate determination of the distribution and thickness of oil being recovered from the water surface. The objective of this study was to develop and apply a multifrequency passive microwave technique to the measurement of oil film thicknesses in a test tank for the quantification of performance data in oil cleanup and containment device evaluation tests.

[from Government Reports Announcements 76(19): #AD-A026 829/2GA. 1976]

C-0049-77
REMOTE SENSING OF ESTUARINE FRONTS AND THEIR EFFECTS ON OIL SLICKS
Klemas, V., and D.F. Polis. 1976.
University of Delaware, College of Marine Studies. Report CMS-RANN-4-76. 48 p.

Remote sensing, Estuaries, Delaware Bay, Drift, Spreading, Oil slicks, Models, *Estuarine fronts

Aircraft and boats were combined to study the behavior of different types of fronts in Delaware Bay and their effect on pollutants in order to provide a basis for improving an oil drift and spreading model. Imagery from the LANDSAT satellites provided the most effectivu means of determining the location and extent of frontal systems over all portions of the tidal cycle.

C-0050-77
A NEW CONCEPT FOR THE REMOTE MEASUREMENT OF OIL FLUORESCENCE CONVERSION EFFICIENCY
Kung, R.T.V., and I. Itzkan. 1975.
International Symposium on Remote Sensing of Environment, 10th, Ann Arbor, Michigan, 1975. Ann Arbor, Environmental Research Institute of Michigan, 1975. Vol. 1. p. 231-241.

Remote sensing, Oil spills, *Oil fluorescence conversion efficiency

"A method is proposed for the absolute remote measurement of oil fluorescence conversion efficiency during the remote monitoring of oil spills from an aircraft using a laser as an excitation source. The method employs the integrated water Raman return as a reference that is calibrated by the measurement of the temporal Raman decay constant without prior knowledge of the oil film thickness. The oil fluorescence conversion efficiency is a good identifier of oil types since it spans over three orders of magnitude from heavy residual to light oils."

[from International Aerospace Abstracts 16(16): #A76-35020. 1976]

C-0051-77
DETECTION AND ANALYSIS FOR WATER SURFACE COVERED WITH OIL FILM
Matsui, M., S. Tsutsumi, and T. Takagi. 1975.
International Symposium on Remote Sensing of Environment, 10th, Ann Arbor, Michigan, 1975. Ann Arbor, Environmental Research Institute of Michigan, 1975. Vol. 1. p. 223-230.

Remote sensing, Detection, Oil slicks, *Infrared sensors

Discrimination of target areas from additive background radiation presents a serious problem to passive infrared sensors operating in the 10 to 13 micron range. Both the scanning angle dependence of the spatial radiance distribution over the sea surface, and the relationship of the sea surface radiance vs. the thickness of oil film by which the water surface is uniformly covered are discussed in the report.

[from International Aerospace Abstracts 16(16): #A76-35019, 1976]

C-0052-77
REMOTE SENSING REPORT. BALTIMORE HARBOR AND WICOMICO RIVER BASIN, MARYLAND
National Field Investigations Center - Denver. 1974.
Environmental Protection Agency report. 208 p.

Remote sensing, Harbors, Rivers, Maryland, Wastewaters, Oil discharges, Water quality, *Oil pollution

The title investigation was conducted on 9 May 1973, for the purpose of documenting the presence of discharges of wastewater to the Harbor from municipal and industrial sources, storm drains, and other unidentifiable sources. Observed discharges were compared to known industrial wastewater discharges to identify locations of potential sources that had not filed for waste discharge permits. The relative magnitude, color, dispersion behavior, and levels of concentrations of the detected discharges and resulting plumes were documented.

[from Government Reports Announcements 76(20): #PB-255 592/8GA, 1976]

C-0053-77

THE THERMAL RADIO EMISSION OF A CONTAMINATED SEA SURFACE

Rayzer, V.Y., Y.A. Sharkov, and V.S. Etkin. 1976.
Report, NASA-TT-F-17033, PR-237; Contract NASW-2790. 32 p.

Remote sensing, Contaminants, Oceans, Oil slicks, Emulsions, *Thermal radiation, *Fluid films

Radiation characteristics of water-film structures were calculated based on such parameters as thickness and temperature for various dielectric properties of contaminant oil films, with allowance for the formation of water-oil emulsions. Remote sensing applications of such radiation characteristics are discussed.

[from Scientific and Technical Aerospace Reports 14(17): #N76-26716. 1976]

C-0054-77

REMOTE SENSING OF AN OIL OUTFLOW ACCIDENT AT THE INLAND SEA OF JAPAN

Shimoda, H., T. Sakata, S. Tatsumi, and K. Tanaka. 1976.
American Society of Photogrammetry and American Congress on Surveying and Mapping Convention, Phoenix, Arizona, 1975.
Falls Church, Virginia, American Society of Photogrammetry, 1976. p. 344-363.

Remote sensing, Oil spills, Oil slicks, Spreading, Sea of Japan

A cracked oil tank spilled 8000 kiloliters of heavy oils into the Inland Sea of Japan in 1974. A recent investigation of remaining oil slicks using remote sensing found high altitude natural color photography the best method for determining oil spreading patterns. Thickness of oil slicks can be approximated using thermal scanning and red tides, and oil slicks can be distinguished using green, blue, and infrared bands.

[from International Aerospace Abstracts 16(19): #A76-38518. 1976]

C-0055-77
THE UTILITY OF SKYLAB PHOTO-INTERPRETED EARTH RESOURCES DATA IN STUDIES OF MARINE GEOLOGY AND COASTAL PROCESSES IN PUERTO RICO AND THE VIRGIN ISLANDS
Trumbull, J.V.A. 1975.
Final report. NASA-CR-147437; NASA Order T-4658-B. 141 p.

Remote sensing, Coasts, Sediments, Coral reefs, Oil slicks, Puerto Rico, Virgin Islands, *Skylab

Three Skylab earth resources passes over Puerto Rico and St. Croix in 1974 and 1975 resulted in color photography and multispectral photography and scanner imagery. Bathymetric and turbid water features are differentiable by use of the multispectral data. Photography allows mapping of coral reefs, offshore sand deposits, areas of coastal erosion, and patterns of sediment transport. Effluent discharges and oil slicks are readily detected and distinct from other phenomena by the persistence of their images into longer wavelength multispectral bands.

[from Government Reports Announcements 76(20): #E76-10414, 1976]

C-0056-77
RADAR OBSERVATIONS OF CONTROLLED OIL SPILLS
van Kuilenberg, J. 1975.
International Symposium on Remote Sensing of Environment, 10th, Ann Arbor, Michigan, 1975. Ann Arbor, Environmental Research Institute of Michigan, 1975. Vol. 1. p. 231-241.

Remote sensing, Oil slicks, Oil spills, Detection, *Radar

Studies and experiments of radar detection of oil slicks on the sea surface are described. Scatterometer tests in a wave tank indicate that oil is always detectable, but oil type and thickness have little influence on the radar echo. The radar observation of the wave damping effect of oil films is proposed as a useful indicator of the physical properties of the oil.

[from International Aerospace Abstracts 16(16): #A76-35020, 1976]

C-0057-77
REMOTE SENSING OF LUMINESCING ENVIRONMENTAL POLLUTANTS USING A FRAUNHOFER LINE DISCRIMINATOR (FLD)
Watson, R.D., W.R. Hemphill, and R.C. Bigelow. 1975.
International Symposium on Remote Sensing of Environment, 10th, Ann Arbor, Michigan, 1975. Ann Arbor, Environmental Research Institute of Michigan, 1975. Vol. 1. p. 203-222.

Remote sensing, Detection, Oil spills, Natural seepage, *Fraunhofer Line Discriminator

A redesigned Fraunhofer Line Discriminator (FLD) was field tested for its ability to detect luminescent water pollutants. The instrument has demonstrated its usefulness for detecting and monitoring several sources of pollution including oil spills and oil seeps.

[from International Aerospace Abstracts 16(16): #A76-35018. 1976]

4. SAMPLING

C-0058-77
SAMPLING AND IDENTIFICATION OF POLLUTANT OILS IN INDUSTRIAL WATERCOURSES. FINAL REPORT, JULY 1968-JULY 1971
Baier, R.E., E.A. Gasiecki, R.P. Leonard, and E.J. Mack. 1976.
Environmental Protection Agency report, EPA-600/2-76-031;
PB-249362/5. 256 p.

Samplings, Oil slicks, Analytical techniques, Chromatography, Spectrometry

Simple quantitative methods are described for sampling oil slick layers up to several centimeters in thickness and subject to varying degrees of weathering, emulsification or admixture with debris. Various gas chromatography and infrared spectrometry techniques used in pollutant analyses are considered with emphasis on the comparison of oil slick components to those present in industrial effluents.

[from Scientific and Technical Aerospace Reports 14(16): #N76-25697. 1976]

C-0059-77
ALIPHATIC HYDROCARBONS FOUND IN MUSSELS IN THE GULF OF VENICE, USED AS A REFERENCE BASE FOR ESTIMATING THE DEGREE OF POLLUTION OF THE LAGOON [English summary]
Fossato, V.U., and E. Siviero. 1975.
Atti Della Accademia Nazionale Dei Lincei Memorie Classe Di Scienze Fisiche Matematiche e Naturali 58(4):641-646.

Sampling, Mollusks, Hydrocarbons, Chemical analysis, Chromatography, Adriatic Sea, *Mussels, *Gulf of Venice

Twenty samples of the mussel, *Mytilus galloprovincialis*, were collected from an offshore survey platform in the Upper Adriatic Sea, and analyses using gas chromatography indicated low levels of contamination from fossil fuels but a significant level of some hydrocarbons of recent biogenic origin. Aliphatic hydrocarbon concentrations had a mean value of 0.65 ± 0.11 mg/100 g wet weight; this was used as a reference base for oil pollution studies in the Lagoon of Venice.

[from Aquatic Sciences and Fisheries Abstracts 6(10): #6Q11068. 1976]

C-0060-77

PROBLEMS OF THE OIL POLLUTION MEASUREMENTS OF MARINE ENVIRONMENTS
[in Japanese]
Hayano, S. 1976.
Seisan Kenkyu 28(3):85-91.

Sampling, Hydrocarbons, Detection, Solubility, Seawater

"A review with 11 references of solubility of hydrocarbons in water and detection and determination of oil pollution in seawater."

[from Chemical Abstracts 85(18): #129900c. 1976]

5. ANALYSIS

C-0061-77
IDENTIFICATION OF OIL COMPONENTS BY GAS CHROMATOGRAPHY FOLLOWED BY LOW TEMPERATURE LUMINESCENCE ANALYSIS
Brownrigg, J. T., and A. W. Hornig. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 406. Abstract.

Oil spills, Hydrocarbons, Analytical techniques, Chromatography
*Luminescence, *Component identification

Major emitting components of oil were identified by gas chromatography followed by low temperature (77°K) luminescence analysis. Specific oil components, such as naphthalene derivatives, were measured quantitatively. The luminescence of non-chromatographed samples was interpreted using data on individual components, leading to a better basis for the methods of oil identification now in use.

[from Pollution Abstracts 7(5):#76-04253. 1976]

C-0062-77
CHARACTERIZATION OF MICROBIAL ISOLATES FROM AN ESTUARINE ECOSYSTEM: RELATIONSHIP OF HYDROCARBON UTILIZATION TO AMBIENT HYDROCARBON CONCENTRATIONS
Buckley, E. N., R. B. Jonas, and F. K. Pfaender. 1976.
Applied and Environmental Microbiology 32(2):232-237.

Hydrocarbons, Analytical techniques, Spectroscopy, Microorganisms, Estuaries, North Carolina

Water collected at 12 sites in the Neuse River estuary of North Carolina was analyzed for total viable counts and total hydrocarbons. Fluorescence spectroscopy indicated petroleum hydrocarbon concentrations ranging from 5 to 70 ng/ml. Microbial species isolated from each site were tested for their ability to grow using kerosene as a sole carbon source; at all but two stations the majority of the species exhibited growth.

C-0063-77
PHOTOMICROGRAPHS CAN HELP ASSESS EFFICIENCY OF OIL-REMOVAL OPERATION
Churchill, R. J. and C. W. Burkhardt. 1976.
Oil and Gas Journal 74(24):76-82.

Analytical techniques, Monitoring, Oil-water separation, Design and engineering

"Emulsion stabilized, photographed and number and size of droplets counted using a microscope. Unit transportable. Experience in its use for monitoring ballast water, coagulation-flocculation and flotation parallel plate oil removal systems given"

[from Industrial Wastes Information Bulletin 7(4):#HMS 7543. 1976]

C-0064-77

THE ORIGIN OF STOMACH OIL IN MARINE BIRDS: ANALYSES OF THE STOMACH OIL FROM SIX SPECIES OF SUBANTARCTIC PROCELLARIIFORM BIRDS

Clarke, A., and P. A. Prince. 1976.
Journal of Experimental Biology and Ecology 23(1):15-30.

Chemical analysis, Chromatography, Hydrocarbons, Birds, *Subantarctic pelagic birds, *Stomach oil, Monitoring

The title study was conducted using thin-layer and gas chromatography to determine differences in the stomach oil composition between species and among individuals of the same species. Analysis of stomach oil from pelagic birds may be valuable in monitoring offshore pollution; however, no substantial pollution by petroleum hydrocarbons was indicated by the present samples.

[from Chemical Abstracts 85(17):#119939 h. 1976]

C-0065-77

FEATURE EXTRACTION TECHNIQUES FOR CLASSIFICATION AND IDENTIFICATION OF SPECTRAL SIGNATURES

DeFigueiredo, R. J. P. 1976.
Technical report, EE-TR-7605; Contract NAS9-12776. 5 p.

Oil spills, Source identification, *Spectral signatures

Study results on the extraction of features from spectral signatures for the purpose of classifying and identifying these signatures are described.

[from Government Reports Announcements 76(21):#AD-A027 848/1GA. 1976]

C-0066-77

COMPARATIVE HYDROCARBON CONTENT OF ALGAE FROM A SAN FRANCISCO BAY WHARF AND A CALIFORNIA COASTAL INLET

DiSalvo, L. H., H. E. Guard, and K. Try. 1976.
Phycologia 15(2):245-247.

Hydrocarbons, Algae, San Francisco Bay, Carcinogens, PAH, Estuaries, Food Web, California

The total hydrocarbon content of *Ulva* and *Enteromorpha* collected from the Oakland-Alameda estuary and Drakes Estero in California was analyzed. Polynuclear aromatic hydrocarbons (PAH) were detected in algae from the San Francisco Bay. This is particularly relevant to studies of the transfer of potentially carcinogenic hydrocarbons through estuarine food webs.

[from Aquatic Sciences and Fisheries Abstracts 6(9):#6Q9905. 1976]

C-0067-77
TECHNIQUES FOR DETERMINATION OF BENZO(A)PYRENE IN MARINE ORGANISMS AND SEDIMENTS
Dunn, B. P. 1976.
Environmental Science and Technology 10(10):1018-1021

Chemical analysis, PAH, *Benzo(a)pyrene, Chromatography, *Fluorimetry, Monitoring, Marine organisms, Sediments

The techniques involve alkaline digestion of samples, column chromatography on Florisil, DMSO extraction, separation of polyaromatic hydrocarbons (PAH) by thin-layer chromatography, and measurement of benzo(a)pyrene by fluorimetry. Radioactive benzo(a)pyrene is used as an internal standard in measuring the recoveries of the compound for each sample. The procedures appear more than adequate for monitoring PAH carcinogens in the marine environment.

C-0068-77
ESTIMATION OF HYDROCARBON CONCENTRATIONS IN THE WATER COLUMN OF COME-BY-CHANCE BAY; 1971-1973
Gordon, D. C., Jr., P. D. Keizer, and P. S. Chamut. 1976.
Fisheries Research Board of Canada Technical Report 442. 13 p.

Hydrocarbons, Seawater, Analytical techniques, Spectroscopy, Refineries, Canada, Environmental effects, *Come-by-Chance Bay

Fluorescence spectroscopy was used to obtain estimates of hydrocarbon concentrations during construction of the Newfoundland Refining Company refinery. Monthly average concentrations ranged from 0.6 to 5.5 ug/l. There were no consistent vertical or horizontal gradients in concentrations. These data can be used to help assess the environmental impact of the refinery.

C-0069-77
PACKED HIGH-PERFORMANCE G-L COLUMNS (ABOUT 50,000 HETP) FOR PROFILE ANALYSIS OF CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN FOODS, MINERAL OIL PRODUCTS, VEHICLE EXHAUST, AND CIGARETTE SMOKE CONDENSATE, ETC.
Grimmer, G., H. Böhnke, and A. Hillebrandt. 1976.
Fresenius' Zeitschrift für Analytische Chemie 279(2):139-140.

Chemical analysis, Chromatography, PAH, Petroleum products, Gasoline

Modifications in the use of gas chromatography for identifying polycyclic aromatic hydrocarbons (PAH) are described. Packed high-performance gas chromatography columns have high separation effect and are capable of characterizing a large number of PAH compounds, many of which occur in gasoline and other petroleum products.

C-0070-77
LOS ANGELES HARBOR FIELD INVESTIGATION OF OIL AND SEAWATER BACKGROUND LUMINESCENCE SIGNATURES
Gross, H. G. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 405. Contract DOT-CG-61980-A. Abstract.

Oil spills, Seawater, California coast, Analytical techniques, *Luminescence signatures, *Los Angeles Harbor

UV laser induced luminescence signatures were determined for five sites in Los Angeles Harbor and one inland water source. An analysis of the similar signatures suggests that oil and grease are the principal pollutants. Reflectance signatures and their relationship to composition need more study.

[from Pollution Abstracts 7(5):#76-04252. 1976]

C-0071-77
THE SOLUBILITY OF SEVERAL AROMATIC HYDROCARBONS IN WATER
Guseva, A. N., and Y. I. Parnov. 1976.
Report No. USAMIIA-K-6467. 5 p.

Solubility, Aromatic hydrocarbons, Analytical techniques, *Polythermic method

Hydrocarbon solubility in various types of natural solutions under various conditions is virtually unknown. The solubilities of aromatic hydrocarbons in water determined in sealed ampules by the polythermic method are reported. Solubility was found to increase with temperature and decrease as the number of methyl groups in the molecule increased.

[from Government Reports Announcements 76(23):#AD-A029 649/1GA. 1976]

C-0072-77
THE IMPORTANCE OF SOLVENT COMPENSATION IN OIL IDENTIFICATION
Helman, D. L., R. A. Passwater, and J. MacEmon. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 403. Abstract.

Oil spills, Analytical techniques. Source identification, *Solvent compensation

"A new solvent compensation mechanism that provides distortion-free spectra for all fluorometric solvents without recalibration when switching solvents is described."

[from Pollution Abstracts 7(5):#76-04250. 1976]

C-0073-77
PETROLEUM ANALYSIS: METHODOLOGY FOR QUANTITATIVE AND QUALITATIVE ASSESSMENT OF OIL SPILL
Hertz, H. S., W. E. May, S. N. Chesler, and B. H. Gump. 1976.
Environmental Science and Technology 10(9):900-903.

Chemical analysis, Oil spills, Chromatography, Spectrometry, Sampling

Chromatographic techniques for petroleum analysis which are compatible with long-term studies of oil spills are discussed. Complementary chemical techniques of gas chromatography and coupled-column liquid chromatography are used for quantification of petroleum samples. Gas chromatography-mass spectrometry is employed for identification of individual components in the samples.

C-0074-77
HYDROCARBON POLLUTANTS IN FISH
Hill, T. B. 1975.
Virginia Journal of Science 26(2):80.

PAH, Fishes, Chemical analysis, Chromatography, Contamination

Column and gas chromatographic procedures were used to determine polynuclear aromatic hydrocarbon (PAH) levels in fish. Extraction procedures and analyses are outlined; contamination levels down to one part per million based on fish weight are detectable.

C-0075-77
THE USE OF TOTAL LUMINESCENCE CONTOUR SPECTRA FOR OIL IDENTIFICATION
Hornig, A. W., H. G. Eldering, and H. J. Coleman. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 407. Abstract.

Oil spills, Analytical techniques, Spectroscopy, Spectrometry, Chromatography, Source identification, *Luminescence

Total luminescence spectroscopy data are presented on six topped crude oils and include contour graphs and standard excitation-emission graphs on the luminescence of crudes dissolved in methyl cyclohexane at room temperature. A wide variety of techniques have been used to extensively study these oils. Total luminescence is evaluated relative to other techniques in respect to usefulness, complexity, cost, and reproducibility.

C-0076-77

INSTRUMENT FOR DETECTING AND MEASURING TRACE QUANTITIES OF HYDROCARBONS IN WATER

Le Rous, J. H. 1974.
South African Patent 74 02,379

Hydrocarbons, Detection, Sampling, Chemical analysis, Design and engineering

Filtration of the water is followed by addition of CCL_4 in a funnel-shaped settling chamber. As the water rises to the top, the CCL_4 settles and is drawn off at the base to a secondary settling chamber from which it is introduced into an analyzer.

[from Chemical Abstracts 85(18):#130315X. 1976]

C-0077-77

ENVIRONMENTAL MEASUREMENTS OF AIR AND WATER QUALITY

Mack, D. A. 1975.
ISPRA Symposium, Stresa, Italy, 1975. NSF Contract W-7405-eng-48.
12 p.

Analytical techniques, Contaminants, Hydrocarbons. *Air quality, Water quality

The most prevalent air and water pollutants resulting from energy conversion processes are listed, and typical concentrations encountered in background and urban settings are given. Methods presently used in the analysis of petroleum hydrocarbons and other pollutants are assessed.

[from Scientific and Technical Aerospace Reports 14(16):#N76-25688. 1976]

C-0078-77

HYDROCARBONS (NORMAL ALKANES) IN THE SURFACE MICROLAYER OF SEAWATER

Marty, J. C., and A. Saliot. 1976.
Deep-Sea Research 23(9):863-873.

Hydrocarbons, Sampling, Chemical analysis, Seawater, *Surface microlayer

A quantitative analysis of dissolved and particulate hydrocarbons in the surface microlayer of the oceans was conducted; samples were collected with a metallic screen. The hydrocarbons were generally of biological origin; however, some petroleum derived hydrocarbons were found.

C-0079-77
GAS CHROMATOGRAPHIC ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN SHELLFISH ON SHORT, WALL-COATED GLASS CAPILLARY COLUMNS
Onuska, F. I., A. W. Wolkoff, M. E. Comba, R. H. Zerose,
M. Novotny, and M. L. Lee. 1976.
Analytical Letters 9(5):451-460.

PAH, Chemical analysis, Chromatography, Marine organisms, *Shellfish

Gas chromatography with short, wall-coated capillary columns was used to analyze polynuclear aromatic hydrocarbons (PAH). The samples were injected onto a precolumn of the injector system and detected by flame ionization. Requirements for routine usage of laboratory-made capillary columns and their application to environmental pollution studies are described.

[from Biological Abstracts 62(8):#46446. 1976]

C-0080-77
IDENTIFICATION OF OIL SAMPLES BY AN ELECTROLYTIC HYDROGEN EXTRACTION AND FLUORESCENCE METHOD
Schwarz, F. P., and S. Wasik. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 408. Abstract.

Oil spills, Sampling, Analytical techniques, *Fluorsscence, *Hydrogen extraction, Source identification

The fluorescence of seawater samples of Bunker C oil, Kuwait crude, Louisiana Crude, and No. 2 Fuel Oil was measured with H_2 bubbled through the samples between fluorescence measurements. Results are given.

[from Pollution Abstracts 7(5):#76-04255. 1976]

6. SOURCE IDENTIFICATION

C-0081-77
SLICK SLEUTHS
Anon. 1976.
Mechanical Engineering 98(7):47.

Source identification, Oil spills, Analytical techniques, Monitoring, Remote Sensing

Researchers at University of Rhode Island have developed and are perfecting a laser-based method for fingerprinting oil spills and possibly hundreds of waterborne substances classified as hazardous by EPA and the U.S. Coast Guard. The method works on the principle that no two contaminants reflect or scatter the light from a laser beam in the same way; thus each pollutant has a unique "fingerprint". The system is adoptable for pollution monitoring and remote sensing of pollutants.

C-0082-77
IDENTIFICATION OF CRUDE AND LUBRICATING OILS BY LOW TEMPERATURE LUMINESCENCE
Fortier, S. H., and D. Eastwood. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 401. Abstract.

Source identification, Oil spills, Analytical techniques, *Luminescence, Crude oil, Lubricating oil, Natural seepage, Pollution control

Luminescence and phosphorescence of crude and lubricating oil dissolved in methylcyclohexane at 77°K were measured, and the effects of weathering on these oils for a week period were examined. The instruments used in the analyses and optimum instrumental settings for each instrument are described. The low temperature luminescence method for petroleum oils has been successfully applied to oil spills and to differentation of natural seeps from closely similar production oils.

[from Pollution Abstracts 7(5):#76-04248. 1976]

C-0083-77
OIL FINGERPRINTING BY PHOSPHORESCENCE: A FEASIBILITY STUDY
Hanks, J. J., and D. Eastwood. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 402. Abstract.

Source identification, Oil spills, Analytical techniques, *Phosphorescence

Phosphorescence of oil was studied by means of a Baird-Atomic Fluorispec fluorescence spectrophotometer, Model SF-100, with a phosphoroscope accessory. Instrumental settings determined for phosphorescence and solvent effects studied are outlined. A standardized phosphorescence method was successfully applied to an actual oil spill.

[from Pollution Abstracts 7(5):476-04249. 1976]

C-0084-77
EXCHANGE OF COMMENTS: SYSTEMS CHEMICAL ANALYSIS OF PETROLEUM POLLUTANTS
Mattson, J. S., and F. K. Kawahara and J. F. Santner. 1976.
Analytical Chemistry 48(13):2022-2023.

Source identification, Chemical analysis, Oil spills, Petroleum products, Sampling

An exchange of comments is presented between J. S. Mattson, National Oceanic and Atmospheric Administration, U.S. Department of Commerce; and F. K. Kawahara and J. F. Santner, U.S. Environmental Protection Agency, regarding the procedures employed by Kawahara and Yang (1976) to characterize and identify unknown oil spill samples to a specific source. (Analytical Chemistry 48:651).

C-0085-77
LIQUID CHROMATOGRAPHIC IDENTIFICATION OF OILS BY SEPARATION OF THE METHANOL EXTRACTABLE FRACTION
Saner, W. A., G. E. Fitzgerald, and J. P. Welsh. 1976.
Analytical Chemistry 48(12):1747-1754.

Source identification, Oil spills, Chemical analysis, Chromatography, Statistical analysis

A liquid chromatographic technique employing dual ultraviolet detection was developed for oil spill identification. Using a methanol-extractable fraction as a fingerprint, a spill chromatogram was made of the oil. The time of spillage was estimated by comparing the standard error of the standard deviations between weathered and unweathered oil chromatograms.

C-0086-77
THIN-LAYER CHROMATOGRAPHIC TECHNIQUE FOR IDENTIFICATION OF WATERBORNE PETROLEUM OILS
Saner, W. A., and G. E. Fitzgerald II. 1976.
Environmental Science and Technology 10(9):893-897.

Source identification, Contaminants, Chemical analysis, Chromatography, Fuel oil, Gasoline, *Fluorescence

The development of a thin-layer chromatographic procedure for the identification of waterborne petroleum oil pollutants is described. After plating on silica-gel, the components of the oil are detected by their fluorescence under ultraviolet light. This fingerprinting technique has been successfully applied to gasolines, fuel oils, and bilge oils.

C-0087-77
OIL FINGERPRINTING USING DOUBLE BEAM FLUORESCENCE SPECTRA
Sheridan, J. E., and J. R. Jadamec. 1976.
Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 1976. Paper No. 404. Abstract.

Source identification, Oil spills, Analytical techniques, *Fluorescence spectra

"Optimum excitation wavelength, sample concentration, and excitation and emission bandpasses were determined, and single beam fluorescence emission spectra for 10 different No. 2 fuel oils were obtained." The rate of photodecomposition which indicated the time length a reference sample could be used, the necessity of using matched cells, and the effect of small concentration variations were studied in the difference spectra." Examples and results are presented

[from Pollution Abstracts 7(5):#76-04251. 1976]

B. OIL POLLUTION PREVENTION AND CONTROL

1. CONTAINMENT

C-0088-77
MATERIALS FOR OIL SPILL CONTAINMENT BOOM
Brunner, D. E. 1976.
Final technical note, Report no. CEL-TN-1440. 32p.

Containment, Oil spills, Booms, *Materials evaluation

A study is described which evaluated containment boom material requirements. From the limited investigation, polyester was the most promising substrate material followed by nylon. Chlorosulfonated polyethylene, polyurethane with a polyether base, chlorinated polyethylene, and poly (vinyl chloride) formulated with ultraviolet inhibitors are the most promising coating materials.

[from Government Reports Announcements 76(17):#AD-A026 139/6GA. 1976]

C-0089-77
FLOATING OIL BARRIERS IN THE USA [in German]
Brus, G. 1975.
Gas - Erdgas 116(7):289.

Containment, Oil spills, Booms, Design and engineering

Two types of floating oil barriers developed by Submarine Engineering Associates, Inc., are described; one is a floating barrier, the other is submersible to facilitate the movement of ships. Both are made from PVC reinforced with adiprenr and are designed to float with about 30 cm above and 60 cm below sea level.

[from Environmental Health and Pollution Control 10(6):1449. 1976]

C-0090-77
DYNAMICALLY EFFECTIVE OIL-GUIDE-BOOM
Steltner, H. A. R. 1976.
Canadian Patent 992,466

Containment, Booms, Oil spills, Design and engineering

A flexible oil-guide-boom and containment barrier is described which facilitates the collection of spilled oil from a water surface. The boom basically consists of flexibly connected, elongate segments which float and support a vertically disposed, oleophilic fabric barrier.

[from Petroleum Abstracts 16(38):#224,971. 1976]

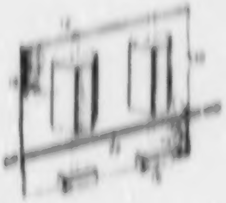
C-0091-76
OIL FENCE
Kinase, T., I. Yano, K. Okubo, H. Kitakoga, and H. Tayama. 1976.
U.S. Patent 3,971,220

Containment, Oil spills, Cleanup, Booms, Design and engineering

A floating oil containment barrier is described which consists of an array of semi-cylindrical floats attached to both sides of an elongate screen and weighted by a chain shaped sinker which is attached to the lower edge of the screen. Means for rolling up and housing the floating barrier are described.

[from Petroleum Abstracts 16(43):#226,175. 1976]

3,971,220
OIL FENCE
Takeo Kinase; Isamu Yano; Kenichi Okubo; Hidetoshi Kitakoga, and Hiromitsu Tayama, all of Sagamihara, Japan, assignors to Mitsubishi Denki Kabushiki Kaisha, Japan
Filed Feb. 13, 1974, Ser. No. 442,131
Claims priority, application Japan, Feb. 23, 1973, 48-23428[U]; Aug. 30, 1973, 48-101721[U]; Dec. 13, 1973, 48-144182[U]
Int. Cl.² E02B 15/04
U.S. Cl. 61—1 F 3 Claims



C-0092-77
SEALING PETROLEUM PRODUCT STORAGE AREAS IN THE NORTH
Thornton, D. E. 1976.
Spill Technology Newsletter 1(4):19-23.

Containment, Fuels, Petroleum products, Storage, Arctic, *Spill containment dikes

Techniques and current practices used in the design, construction, and maintenance of spill containment dikes used in Arctic oil and fuel storage were reviewed for the Environmental Protection Service. In general grouting was not considered suitable for sealing storage areas, whereas the sealing of soil surfaces with thermoplastic molten sulfur is considered one of the most promising techniques.

2. CLEANUP AND RECOVERY

C-0093-77
CO-OP IN SEATTLE OPERATES NEW OIL SPILL RECOVERY VESSEL (news brief)
Anon. 1976.
Sea Technology 17(10):28-29.

Cleanup, Recovery, Oil spills, Puget Sound, Washington, Oil industry, *Spill recovery vessel

A new oil spill recovery vessel, Clean Sounder, can recover up to 2270 l/min (600 gal/min) of spilled oil. Contracted and owned by Clean Sound Co-operative, which is a 14 member organization of oil, barge, and pipeline companies, Clean Sounder operates in the Seattle vicinity of Puget Sound and adjacent waters.

C-0094-77
FERROMAGNETIC FOAM USED TO CLEAN UP OIL SPILLS (news brief)
Anon. 1976.
Ocean Industry 11(10):77.

Cleanup, Recovery, Oil spills, Design and engineering, *Ferromagnetic polyfoam chips

Ferromagnetic foam will be used in an oil spill recovery boat to recover spilled oil on water. The vessel contains a wringer mechanism to squeeze the oil out of the chips and a holding tank to store the recovered oil.

C-0095-77
GAMLEN CLEANBREAK CHEMICAL TANK CLEANER (product information)
Anon. n.d.
Gamlen Chemical Company (UK) Ltd., Wallingford Road, Uxbridge,
Middlesex, UB8 2TD, England, UK.

Wastewater treatment, Cleanup, Oil tanks, Oil-water separation, Reuse

A biodegradable, nontoxic compound is described which is useful in tank cleaning. The compound allows for the rapid separation of oily wash water upon settling and permits the use of oil as a low grade fuel and the direct discharge of washwater.

[from Industrial Wastes Information Bulletin 7(3):#HMS 6978. 1976]

C-0096-77
HEATED OIL SKIMMER (product information)
Anon. 1976.
Pollution Engineering 8(11):40.

Oil spills, Recovery, Skimmers, Design and engineering

The model 6V Oil Skimmer developed by Oil Skimmers, Inc., includes a low wattage heating element that warms the lubricant inside the motor housing and transfers heat to the housing. Heavy oils that cling to the tubing become more fluid when heated and icy scum buildup at the scrapers is prevented.

C-0097-77
LARGEST OIL RECOVERY VESSEL ORDERED FOR IRELAND'S BANTRY BAY
Anon. 1976.
Ocean Industry 11(10):78-79.

Recovery, Oil spills, Skimmers, Design and engineering, Bantry Bay, Ireland

A deep water oil recovery vessel is being built for use in Bantry Bay, Ireland, to serve as a patrol vessel, fire-fighting unit, and recovery system. The boat will contain skimming, oil-water separation, and storage units.

C-0098-77
LASERS TO REMOVE OIL SPILLS? (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(10):180.

Oil spills, Crude oil, Cleanup, Evaporation, Decomposition, *Lasers

The feasibility of using lasers to evaporate, decompose, and burn crude oil on water surfaces is discussed in Environmental Science and Technology 10(8):814. This technique has been applied in tests at sea, and a number of problems have been noted: the effects of wind, waves, and seawater contamination and the evaporation of large quantities of water.

C-0099-77
NEW UNIT CLEANS LIQUID CONTAMINANT SOLIDS AT 100 GPM (product information)
Anon. 1976.
Oil and Gas Journal 74(44):88.

Cleanup, Contamination, Sediments, Design and engineering

The No. 200 Sandwasher employs two hydrocarbons, a flotation tank, plus an accumulator tank. Contaminated solids, like oil-coated sand collected in oil production facilities, are processed. FFI contact Picenco International Inc., 424 Hogan, Houston, TX 77009.

C-0100-77
NEW SYSTEM ABSORBS OIL SPILLS
Anon. 1976.
Naval Research Review 29(1):26-27.

Cleanup, Recovery, Oil spills, Design and engineering, *U.S. Navy, *Polyurethane foam chips

A new open sea oil spill recovery system using polyurethane foam chips has been developed by the U.S. Navy. The chips are sprayed across a 6 m (20 ft) path of oil, guided on to a collecting belt, squeezed dry, and returned for reuse.

[from Aquatic Sciences and Fisheries Abstracts 6(9):#6Q9916. 1976]

C-0101-77
NORWEGIAN OIL-SPILL CLEANUP DEVICES DEVELOPED (news brief)
Anon. 1976.
Ocean Engineering 11(10):77-78.

Cleanup, Recovery, Oil spills, Skimmers, Oil-water separation, Norwegian Sea

A new oil spill skimmer has been developed by Thune-Eureka for use in Norwegian waters. The system will be able to handle up to 180 metric tons/hour (200 tons) of oil and is powered and controlled by the mother ship. The skimmer, boom, and oil-water separation systems are described.

C-0102-77
OIL AND CHEMICAL SPILL RECOVERY (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(8):142.

Cleanup, Recovery, Oil spills, Absorption

Petro-Trap pads are capable of absorbing up to thirty times their weight of oil on land or water and can be wrung out for reuse if spill recovery is necessary. The pads are made of an absorbent polymeric foam core sealed in a spunbonded polypropylene membrane, which is permeable to oil but not to water.

C-0103-77
OIL SPILL RECOVERY DESIGN ALLOWS MANEUVERS IN HIGH SEAS AND ROCKY COASTS (news brief)
Anon. 1976.
Offshore 36(11):118.

Oil spills, Recovery, Spain, Tankers, Design and engineering, *Urquiola oil spill

The Spanish government called in Oil Mop and its British cleanup affiliate, Marine Safety Services, Ltd., to recover oil spilled by the tanker, "Urquiola", after it grounded and burned at the entrance of the port of La Coruna. Rotorks, self-propelled cleanup vessels that pick up 10 to 15 tons of oil per hour, recover oil from the surface of water by running a floating oleophilic rope of polypropylene fibers across the slick.

C-0104-77
OIL-SPILL RESPONSE UNIT (product information)
Anon. 1976.
Chemical Engineering 83(20):139.

Cleanup, Recovery, Oil spills, Booms, Skimmers, Design and engineering

A self-contained, mobile trailer containing all the necessary equipment to combat oil spills has been developed by Slickbar, Inc. The trailer contains 305 m (1000 ft) of control boom, a 4.3 m (14 ft) work boat, skimmer heads, pumping systems, and a portable holding resevoir for 11,350 l (3000 gal) of recovered oil.

C-0105-77
RADIO-CONTROLLED OIL SKIMMER
Anon. 1976.
Journal of Canadian Petroleum Technology 15(3):105.

Skimmers, Oil slicks, Refineries, Recovery, Cleanup, Design and engineering

A radio-controlled skimmer for recovering oil from refinery ponds is described. The device, designed and manufactured by Lockheed, can recover about 150 liters (40 gallons) of oil per minute and works on the principle that oil adheres to a metal surface, whereas water runs off. FFI contact Lockheed Missiles and Space Company, Sunnyvale, CA 94088.

C-0106-77
OIL SPILL CLEANUP AND APPARATUS
Ayers, R. R., and D. P. Hemphill. 1976.
U.S. Patent 3,959,136

Cleanup, Recovery, Oil spills, Skimmers, Design and engineering

A skimmer apparatus is described which is designed for cleanup of small-volume oil spills. The apparatus consists of a pivotable and adjustably inclined skimmer mounted between the sides of a catameran. Oil enters through baffled entry ports and moves down along the inclined plane to a chamber situated beneath an inverted funnel. The collected oil is then withdrawn from the skimmer through the inverted funnel.

[from Selected Water Resources Abstracts 9(22):#W76-11846. 1976]

3,959,136
OIL SPILL CLEANUP METHOD AND APPARATUS
Ray R. Ayers, and Dean P. Hemphill, both of Houston, Tex., assignors to Shell Oil Company, Houston, Tex.
Continuation of Ser. No. [illegible], Sept. 14, 1973, abandoned.
This application Sept. 9, 1974, Ser. No. [illegible]
Int. Cl.² [illegible]
U.S. Cl. 210—83 11 Claims

C-0107-77
STUDY TO EVALUATE INTENSITY OF AND ALTERNATIVE METHODS FOR NEUTRALIZATION OF DOD AIRCRAFT FUEL SPILLS
Cicone, V. J., and A. P. Graves. 1976.
Final technical report, DOD-AGFSRS-76-2. 93p.

Fuels, Cleanup, *Fuel spills, *Neutralization

The magnitude of the fuel spill problem at DOD airfields in terms of fuel volume, frequency of occurrence, and specific site of occurrence is outlined. A list of currently available methods for neutralization of fuel spills was prepared, together with a study of the methods for collection, treatment, or neutralization of accidental fuel spills at airfields.

[from Government Reports Announcements 76(17):#AD-A025 937/4GA. 1976]

C-0108-77
CONTROLLED COMBUSTION TESTS CARRIED OUT NEAR RIMOUSKI
Coupal, B. 1976.
Canada. Environmental Conservation Directorate. Environmental Protection Service Technology Development Report EPS-4-EC-76-2. 23p.

Cleanup, Oil spills, Disposal, Incineration, Canada

Six tests were conducted in which Creuta crude oil and bunker C oil were burned on water and on ice as a feasible technique of disposing of oil spills. A ratio of 1,814 g (4 lb) of peat: 33.5 l (9 gal) oil and 1/2 l of diesel fuel: 453.6 g (1 lb) of peat is an optimal combination. The combustion of fresh oil and water performed with 85% efficiency. This technique appears to be potentially useful in spills where oil is contained naturally or in booms.

[from Pollution Abstracts 7(5):#76-04490. 1976]

C-0109-77

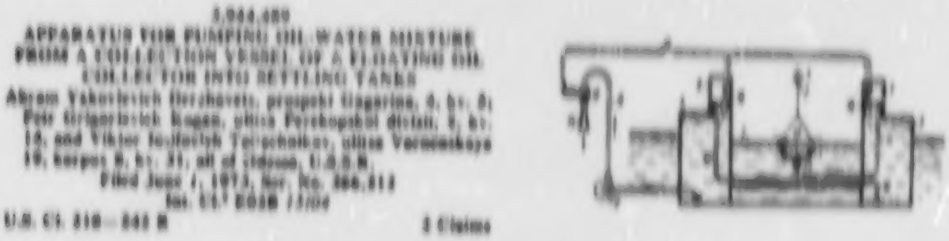
APPARATUS FOR PUMPING OIL-WATER MIXTURE FROM A COLLECTION VESSEL OF A FLOATING OIL COLLECTOR INTO SETTLING TANKS

Derzhavets, A. Y., P. G. Kogan, and V. I. Tabachnikov. 1976. U.S. Patent 3,944,489

Cleanup and recovery, Oil spills, Oil transfer, Oil-water separation, Design and engineering

A complex apparatus is described for pumping an oil-water mixture from the collection vessel of a floating oil collector into oil-water separation and settling tanks.

[from Selected Water Resources Abstracts 9(16):#W76-08403. 1976]



C-0110-77

SURFACE-ACTIVE, BIODEGRADABLE ORGANIC DISPERSANTS

Durif-Varambon, B., C. Bocard, C. Gatellier, and B. Sillion. 1976.

German Offenlegungsschriften (unexamined patent application) 2,558,907

Cleanup, Oil spills, Dispersants, Surfactants

When trimethylolpropane monooleate, glycerol monostearate, and 1-dodecanol or a similar compound are ethoxylated and treated with glutamic acid; a biodegradable, nontoxic surfactant results which is useful for dispersing crude oil in water.

[from Chemical Abstracts 85(13):#96126z. 1976]

C-0111-77
SURFACE-ACTIVE, NITROGEN-CONTAINING, BIODEGRADABLE, ORGANIC DISPERSION MATERIAL FOR PURIFYING POLLUTED WATER SURFACES
Durif-Varambon, B., C. Bocard, C. Gatellier, and B. Sillion. 1976.
German Offenlegungsschriften (unexamined patent application) 2,558,909

Oil spills, Cleanup, Dispersants, Surfactants

Biodegradable surfactants for dispersing crude oil and similar substances in water are prepared by treating esters of glutamic acid containing 1-dodecanol, glycerol monostearate, or similar compounds with ethylene oxide.

[from Chemical Abstracts 85(13):#96125y. 1976]

C-0112-77
BERGEN COMPANY INTRODUCES THE "OIL MOP"
Ellingsen, E. 1976.
Northern Offshore 5(7):10,12.

Cleanup, Recovery, Oil spills, Oil-water separation

Oil Mop, Inc. (OMI) oil spill recovery equipment and oil/water separation devices are now represented in Norway by Norsk Stalpress A/S of Bergen. The equipment is designed to be air deliverable, and the spill recovery systems are guaranteed to effectively absorb and/or separate oily wastes from water.

[from Petroleum Abstracts 16(39):#225,196. 1976]

C-0113-77
ENVIRONMENT PROTECTIVE OIL SKIMMING AND REMOVAL APPARATUS
Fast, S. G. 1976.
U.S. Patent 3,947,360

Skimmers, Cleanup, Recovery, Oil spills, Design and engineering

A catamaran-mounted oil skimming apparatus is described. The skimmer boat is provided with a central conveyor belt and collection tanks. The conveyor belt collects the oil and brings it to the upper end of the belt where scrapers direct the oil into the holding tanks.

[from Selected Water Resources Abstracts 9(17):#W76-09048. 1976]

3,947,360
ENVIRONMENT PROTECTIVE OIL SKIMMING AND
REMOVAL APPARATUS
Sven Gunnar Fast, Sandviken, Sweden, assignor to Sandco
Limited, Ottawa, Canada
Continuation of Ser. No. 391,554, Aug. 27, 1973, abandoned.
This application Oct. 31, 1974, Ser. No. 519,763
Int. Cl.² E02B 15/04
U.S. Cl. 210—242 S 3 Claims

C-0114-77
EVALUATION OF UTILITY EQUIPMENT FOR HARBOR OIL SPILL REMOVAL/RECOVERY SYSTEMS
Garg, S. C. 1976.
Report, CEL-TN-1443. 116p.

Oil spills, Recovery, Cleanup, Design and engineering, *Equipment evaluation

Evaluations are given of the following equipment for oil spill cleanup: a power assistance unit for deploying and retrieving a boom, a 6.1 m (20 ft) utility boom, a 8.5 m (28 ft) flattop boat, three boom mooring systems, a dust abatement attachment for a sorbent distributor, and associated connectors, shackles, and lines. The test program and results are described and recommendations are presented.

[from Government Reports Announcements 76(18):#AD-A026 252/7GA. 1976]

C-0115-77
OIL CAPTURING AGENT AND METHOD
Idemitsu Kosan Co., Ltd. 1975.
British Patent 1,414,826

Oil spills, Cleanup, Recovery, Adsorption, *Polyethylene foam

The adsorbent is a polyethylene foam containing 30-80% by weight of inorganic calcium salt with a density of 0.06-0.10 gram/cm^3. The foam is spread over the surface of the sea to adsorb spilled oil.

[from Industrial Wastes Information Bulletin 7(2):#HMS 6625. 1976]

C-0116-77
A COLD WATER OIL RECOVERY SYSTEM
Logan, W. J. 1976.
Spill Technology Newsletter 1(4):18.

Recovery, Oil spills, Crude oil, Petroleum products, Design and engineering, *Cold water recovery

Oil Mop Pollution Controls Ltd. is developing a modification for their oleophilic rope oil recovery system which will enable the equipment to collect and recover highly viscous crude oils and petroleum products which are common at low temperatures. A prototype unit is expected to be field tested by early 1977.

C-0117-77
A STUDY OF THE REMOVAL OF OILY SOIL BY ROLLING UP IN DETERGENCY
Ogino, K., and W. Agui. 1976.
Bulletin of the Chemical Society of Japan 49(6):1703.

Cleanup, Contamination, Soil, *Detergents

Summary not available.

[from Current Contents: Physical and Chemical Sciences 16(32): 104. 1976]

C-0118-77
THE CYCLONET, A COLLECTION APPARATUS FOR HYDROCARBONS ON THE SURFACE OF THE SEA [in French]
Pichon, J. 1975.
The Mediterranean and the Fight Against Marine Pollution Caused by the Production, Transport, and Transformation of Energy and Primary Energetic Matter. Monaco, International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), 1975. p. 59-64. Proceedings of the work of the Committee for the Fight Against Marine Pollution during the 24th Plenary Congress-Assembly, Monaco, December, 1974.

Recovery, Oil-water separation, Skimmers, Oil spills, Design and engineering

The development and operation of the 'Cyclonet', an oil-water collector and separator, are described. The oil polluted water is skimmed off within a hydrocyclone which then returns the cleaned water to the sea.

[from Aquatic Sciences and Fisheries Abstracts 6(3):#6Q3326. 1976]

C-0119-77
PROCEDURE TO SEPARATE HYDROCARBONS FROM WATER [in Dutch]
Preus, P. 1974.
Netherlands Patent Application 7,416,148

Hydrocarbons, Recovery, Absorption, Oil-water separation, *Oleophilic material

An oleophilic and hydrophobic material made of a loose mass of expanded perlite, asphalt, and fiber-filling substance absorbs hydrocarbons selectively; the hydrocarbons can then be mechanically removed from the material.

[from Petroleum Abstracts 16(49):#227,673. 1976]

C-0120-77
CURRENT DISPERSANT ACTIVITIES IN THE ENVIRONMENTAL EMERGENCY BRANCH
Ross, C. W. 1976.
Spill Technology Newsletter 1(4):38-40.

Oil spills, Dispersants, Toxicity, Regulations, Bibliographies, Canada

The Environmental Emergency Branch (EEB) of the Environmental Protection Service is conducting several projects concerning the field effectiveness, toxicity, application techniques, and regulation of oil spill dispersants. In addition to the testing program, the EEB will publish a comprehensive bibliography on dispersants in 1977.

C-0121-77
CLEANING AND EMULSIFICATION OF MAZUTS BY SOLUTIONS OF NONIONIC SURFACTANTS [English summary]
Smirnova, A. V., A. F. Koretskii, and V. A. Kolosanova. 1976.
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Khimicheskikh Nauk. No. 1:140-145.

Cleanup, Contamination, Storage, Oil tanks, *Residual oil, Emulsification

"The removal of petroleum-refining-residual-oil contamination from storage and transportation vessels was accomplished by washing and emulsification with OP-4 dissolved in petroleum spirits on diesel fuels. The presence of electrolytes was detrimental."

[from Chemical Abstracts 85(10):#65444x. 1976]

C-0122-77
TESTING AND EVALUATION OF THE BENNETT POLLUTION CONTROLS LTD MARK IV SKIMMER
Solsberg, L. B. 1976.
Spill Technology Newsletter 1(3):9-12.

Oil spills, Recovery, Design and engineering

Results are presented of field tests of the skimmer unit under controlled conditions in sheltered waters. The unit had a 57% to 100% recovery rate, was stable in 55 km/hr (30 knot) winds, and was also effective in handling debris. Its operability, and minor problems are briefly reviewed.

C-0123-77
A METHOD AND APPARATUS FOR SEPARATING OIL FROM OIL-POLLUTED WATER
Virtanen, A. A. 1976.
British Patent 1,433,928

Recovery, Oil spills, Oil-water separation, Design and engineering

Oil-polluted water was collected by a funnel under the water surface and passed to a submerged separating chamber where the oil floats to the top of the stream, and water passes beneath the oil layer before being pumped into the environment. Injection of air into the water through a perforated tube in the chamber created an additional separating effect.

[from Chemical Abstracts 85(12):#83114u. 1976]

C-0124-77
PROCESS FOR CONTROLLING SURFACE POLLUTANTS
Weiss, D. E., and H. A. J. Battaerd. 1976.
U.S. Patent 3,890,224

Cleanup, Oil spills, Recovery, *Ferromagnetic granules

The use of floating, ferromagnetic, synthetic polymer granules to accumulate oil is described.

[from Environmental Technology and Economics 17:7. 1976]

3. OIL TRANSFER AND TRANSPORT

C-0125-77
SALT OF THE EARTH
Anon. 1976.
Mechanical Engineering 98(7):47.

Oil transfer, Storage, Crude oil, Petroleum products, Safety, Leakage, Economics, *Underground salt caverns

The advantages of using artificial caverns leached out of underground salt domes for temporary or permanent storage of crude oil and petroleum products are discussed. Such storage is safe from sabotage or fire, and leakage is virtually eliminated because of the self sealing properties of the salt. Costs involved are far lower than those for above ground storage.

C-0126-77
TANKER SAFETY AND POLLUTION HAZARDS
Anon. 1976.
Safety at Sea International 83:14-15.

Tankers, Oil discharges, Regulations, Safety

Pollution of the sea by oil tankers, and the effect of new IMCO regulations and technological developments on such oil pollution is briefly discussed. Tank cleaning procedures amount to about 70% of the total oil pollution caused by tankers, and the older, smaller tankers are estimated to contribute 75-80% of such pollutants while they transport only about 25-30% of the world's oil. Recent developments in tanker safety are also reviewed.

C-0127-77
SUPERPORTS: THE NEED IS COMING
Barrett, A. C. 1974.
Vital Speeches of the Day 40:712-714.

Oil transport, U.S., Storage, Tankers, Ports, Economics, Environmental effects

The U.S. is the only major world power presently unable to accommodate supertankers in its ports. Economic and environmental arguments for and against building superports in coastal or offshore U.S. waters are evaluated and discussed.

[from Selected Water Resources Abstracts 9(22):#W76-12017, 1976]

C-0128-77
THE FUTURE OF ENERGY IN OUR SOCIETY
Bunyard, P. 1976.
Ecologist 6(3):87-101.

Oil transport, Oil spills, Environmental deterioration, Chronic effects, Marine organisms

Environmental deterioration associated with the development of energy from coal, oil and nuclear resources is one of the topics examined in the article. Spills resulting from the transport of oil are considered one of the greatest environmental threats, and the generally underestimated chronic biological effects of such spills on marine ecosystems are emphasized. Health hazards from carcinogenic petroleum hydrocarbons are briefly mentioned.

C-0129-77
TANKERS, SAFETY AND THE ENVIRONMENT
Dickson, A. F. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 14p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Tankers, Contamination, Oil transport, Oil discharges, Ballast, Pollution control, Regulations

Accidental oil pollution resulting from structural failures in tankers, collisions between vessels, and groundings are reviewed and compared with operational pollution such as discharging of ballast waters and routine tank washing. The author concludes that the less spectacular but more serious chronic contamination resulting from operational pollution can and must be more adequately controlled by international regulations.

C-0130-77
RISK ANALYSIS METHODS FOR DEEPWATER PORT OIL TRANSFER SYSTEMS
Frenkel, L. and W. T. Hathaway. 1976.
Final report, TSC-USCG-76-2, USCG-D-69-76. 146p.

Oil transfer, Ports, *Risk analysis

The best methods for the assessment of comparative risks from different technical alternatives are failure mode and effect analysis in combination with fault tree analysis.

[from Government Reports Announcements 76(23):#AD-A029 329/0GA, 1976]

C-0131-77
INVESTIGATE FEASIBILITY OF UTILIZING ACOUSTIC EMISSION METHODS TO EVALUATE THE INTEGRITY OF A PROTOTYPE ADAPTS OIL STORAGE CONTAINER
Hutton, P. H. 1975.
Final report, USCG-D-37-76; Contract DOT-CG-23223-A. 38p.

Oil tanks, Storage, Pollution prevention, *Acoustic emission methods

A study is reported of acoustic emission characteristics of nylon fiber-polyurethane material used in the Coast Guard's prototype oil storage container, a subsystem of the Air Deliverable Anti-Pollution Transfer System (ADAPTS). The specific application is concluded to be impractical. Acoustic emission does have potential application for this type of material where a low attenuation signal transmission path such as metal sheathing is available.

[from Government Reports Announcements 76(17):#AD-A025 910/1GA. 1976]

C-0132-77
THE INTERRELATIONSHIP OF MATERIAL TOXICITY, STREAM PROPERTIES, AND QUANTITY OF SPILLED MATERIAL IN ASSESSING THE RISK OF HAZARDOUS MATERIAL SPILLS
Jensen, P. A., and R. W. Hann, Jr. 1976.
College Station, Texas, Sea Grant Program, Texas A & M University. 261p.

Regulations, Oil transfer, Oil spills, Toxicity, *Hazardous material spills

Current status of regulatory efforts for bulk carriage of oil and hazardous materials is reviewed and regulatory weaknesses are discussed. Methods of quantifying pollution risk and severity, and concentrations at which a material will cause acute toxic effects are given.

C-0133-77
ENERGY CRISIS, SUPERTANKERS AND ECOLOGY
Morris, R. C. 1975.
Insurance Counsel Journal 42(4):511-526.

Tankers, Design and engineering, Oil spills, International conventions, Legislation, Liability, Insurance

Presentations given at a forum on the problems of supertankers in relation to oil pollution are transcribed. Among the topics discussed are: international standards for tanker design, construction and operation; U.S. federal and state legislation and international conventions dealing with oil spill liability; and problems of liability insurance, especially the lack of uniformity between national and international legislation.

[from Selected Water Resources Abstracts 9(20):#W76-10735. 1976]

C-0134-77
OIL TERMINAL AT SULLOM VOE: ENVIRONMENTAL IMPACT ASSESSMENT
Sullom Voe Environmental Advisory Group. 1976
Sandwick, Shetland; Thuleprint, Ltd., 1976. 133p.

Oil transfer, *Oil terminal, Environmental effects, Scotland, *Sullom Voe

Summary not available.

[from Nature 263(5578):xiii. 1976]

C-1035-77
PROTECTION OF THE MARINE ENVIRONMENT
Smith, C. C., Jr., L. W. Finlay, and M. S. McKnight. 1975.
Natural Resources Lawyer 8(3):511-533.

Environmental protection, Oceans, Oil spills, Oil discharges, International conventions, Wastewaters, *IMCO

A study on marine oil pollution by vessels conducted by the National Petroleum Council in formulating U.S. governmental policies is summarized. The study indicates that the Intergovernmental Maritime Consultative Organization (IMCO) has been largely responsible for international conventions and agreements dealing with improved ship design, waste treatment, and discharge limitations; and that the organization be named administrative agent for any new international standards.

[from Selected Water Resources Abstracts 9(22):#W76-11982. 1976]

C-0136-77
STRATEGIC PETROLEUM RESERVE: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR BRYAN MOUND SALT DOME: DES-76-6
U.S. Federal Energy Administration. 1976.
Report, FEA/S-76/347. 444p.

Crude oil, Storage, Environmental effects, EIS, *FEA. *Salt domes

The Federal Energy Administration (FEA) proposes to develop a 9.2 billion liters (58 million barrels) crude oil storage facility at the Bryan Mound salt dome as part of its Strategic Petroleum Reserve program. The extreme geologic stability of salt domes and the low cost of bulk underground storage favor this type of facility. The final environmental statement analyzes the possible environmental impacts resulting from this development.

[from Petroleum Abstracts 16(43):#226,189. 1976]

C-0137-77
STRATEGIC PETROLEUM RESERVE: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR WEST HACKBERRY SALT DOME: DES-76-4
U.S. Federal Energy Administration. 1976.
Report, FEA/S-76/346. 515p.

Crude oil, Storage, Environmental effects, EIS, *FEA, *Salt domes

The Federal Energy Administration (FEA) proposes to develop a 915 billion liters (60 million barrels) crude oil storage facility at the West Hackberry salt dome as part of the Strategic Petroleum Reserve program. The extreme geologic stability of salt domes and low cost of bulk underground storage favor this type of storage. This final environmental statement analyzes the environmental impacts caused by the development and operation of the proposed facility.

[from Petroleum Abstracts 16(43):#226,190. 1976]

4. WASTE TREATMENT AND DISPOSAL METHODS

C-0138-77
SELF-PROPULSIVE OIL-WATER SEPARATION VESSEL; THE OCEANGREEN [English summary]
Adachi, M. 1975.
Hitachi Zosen Technical Review 36(1):51-55.

Wastewater treatment, Oil-water separation, Bilges, Tankers, Japan

The vessel described was remodelled from a whaling factory ship and is Japan's first self-propelled oil-water separation vessel. It is designed to receive oily wastewaters from supertankers in transit, and it can process such wastewaters at up to about 300 tons per hour.

C-0139-77
CONCRETE OIL/WATER SEPARATOR BARGE (product information)
Anon. n.d.
Marine Concrete Structures, Inc., P.O. Box 607, Metairie, Louisiana 70004

Wastewater treatment, Oil-water separation, Design and engineering, *Floatable barges

A product line of floatable oil/water separator barges is described. The units utilize gravity separation to remove and collect oil rapidly and efficiently, surpassing EPA requirements.

C-0140-77
FILTERS SPLIT EMULSIONS
Anon. 1975.
Betriebstechnik 16(5):16.

Wastewater treatment, Emulsions, Oil-water separation, Filtration, *Ultrafiltration

Ultrafiltration methods which use membranes to selectively pass water molecules but stop larger oil molecules are described. Several industrial processes which use ultrafiltration to separate oily wastes from their effluents are discussed.

[Environmental Health and Pollution Control 10(6):1431. 1976]

C-0141-77
HOLLOW FIBER ULTRAFILTRATION OIL WASTES (product information)
Anon. 1976.
Pollution Engineering 8(9):58.

Waste oil treatment, Oil-water separation, Emulsions, Design and engineering

A hollow fiber ultrafiltration system for the treatment of oil wastes is capable of processing 114,000 l/d (30,000 gal/d) of oil-water emulsions and can reduce the volume of wastes by as much as 95 percent.

C-0142-77
HYDE OIL-WATER SEPARATION (product information)
Anon. n.d.
Gulf Oil Co. - Eastern Hemisphere, 810 Sharon Drive, Cleveland, Ohio 44145

Oil-water separation, Wastewater treatment, Design and engineering

"A device using the accelerated separation of 90% to 100 ppm insoluble oil from water when flowing through porous media is described. Advantages include legal efficiency (down to 1 ppm), space saving, no filters, cartridges or moving parts and a wide range of capacities."

[from Industrial Wastes Information Bulletin 7(4):#HMS 7553, 1976]

C-0143-77
NEW COALESCER INTRODUCED (product information)
Anon. 1976.
Oil and Gas Journal 74(42):90.

Wastewater treatment, Oil-water separation, Coalescence, Design and engineering

The Hydro-Gard coalescer removes oil from wastewater to give a free oil content of 5 to 10 ppm and can be used in coordination with oil skimming systems. FFI contact Inland Environmental, 5454 N. Wolcott St., Chicago, IL 60640.

C-0144-77
OIL-EMULSION-BREAKING PLANT
Anon. 1976.
Chemical Engineering 83(24):94.

Wastewater treatment, Oil-water separation, Emulsions

This plant, called Oecomat, handles almost all kinds of emulsions of varying quantity, nature, and concentrations. The unit delivers concentrated sludge containing 40% water; the effluent is said to contain less than 20 mg/l of oil. The operation of the plant is briefly explained.

C-0145-77
OIL-WATER SEPARATORS, SHIPBOARD WASTE TREATMENT SYSTEMS
(product information)
Anon. n.d.
Hyde Products, Inc., 810 Sharon Drive, Westlake, Ohio 44145

Wastewater treatment, Oil-water separation, Ships

Oil-water separation systems which utilize gravity-surface tension effects in permeable bed are described. Oil in water effluent is reduced to below 5 ppm using this sytem. Information on a complete, portable, physico-chemical sewage treatment plant is also presented.

[from Industrial Wastes Information Bulletin 7(2):#HMS 6898, 1976]

C-0146-77
OIL/WATER SEPARATOR EQUIPMENT AVAILABLE (product information)
Anon. 1976.
Oil and Gas Journal 74(42):90.

Wastewater treatment, Oil-water separation, Coalescence,
Wastewater disposal, Bilges, Ballast

Oil-water separator equipment that uses coalescing plates to clean oily wastewater or to remove oil from bilge and ballast water is now on the market. These separators permit wastewater disposal under federal and state environmental pollution regulations and aid in the recapture of valuable oils. FFI contact General Electric Co., Re-Entry and Environmental Systems Div., 3198 Chestnut St., Philadelphia, PA 19101.

C-0147-77
SHELL'S CLYDE REFINERY: NEW CLOSED CIRCUIT COOLING WATER SYSTEM
Anon. 1975.
PACE 28(10):13-16.

Refineries, Wastewater treatment, Petrochemicals, Oil spills, Conservation, Australia

Details of the development of a $5.5 million comprehensive water conservation and effluent treatment system for the Clyde Shell refinery and petrochemical complex in New South Wales are presented. Effluent treatment programs began with a comprehensive system to intercept and collect all oil spillage from all process units and tank farms. This program reduced oil content in the effluent to below 2 ppm (average). Next, a wastewater treatment system was added to eliminate dissolved oils, chemicals, and suspended solids in drainage, processing, and cooling system waters. Recently installed closed-circuit cooling water facilities, which make the refinery processes independent of the adjacent Parramatta and Duck rivers, complete the water conservation and effluent treatment systems.

C-0148-77
SKIMJET OIL REMOVER AND COLLECTOR (product information)
Anon. n.d.
Skimovex B. V., 135 Binchhorstlaan, P.O. Box 1406, The Hague 2077, The Netherlands

Wastewater treatment, Oil-water separation, Tankers, Refineries, Oil wells, Design and engineering

"Jets of water create a downstream which attracts and carries oil to a reservoir. Capacity 10,000 l/hr. Oil-water separators for factories, oil rigs, tankers and refineries are also described."

[from Industrial Wastes Information Bulletin 7(2):#IW6 6558. 1976]

C-0149-77
WASTEWATER TREATMENT IN THE SISAK REFINERY [English summary]
Baric, J. 1976.
Hemijska Industrija 30(2):65-70.

Wastewater treatment, Refineries, Sludge, Incineration, Yugoslavia

The centralized waste treatment system and individual process characteristics for wastes from a Yugoslav oil refinery are described. The system includes pretreatment, physical, chemical, and biological treatment, and incineration of the biological sludge.

[from Chemical Abstracts 85(18):#129934s. 1976]

C-0150-77
PROTECTION OF THE ENVIRONMENT AGAINST POLLUTION BY SHIPS
Bayler, G., and C. Monte. 1976.
Technik 30(8):534-538.

Wastewater treatment, Wastewater disposal, Waste oil disposal, Ships, Environmental protection

Various types of available equipment for treating and disposing of shipboard wastes, including oily wastes, are explained with regard to their construction and mode of operation.

[from Environmental Health and Pollution Control 10(6):#1421. 1976]

C-0151-77
REFINERIES AND TERRITORY. TRANSPORT OF POLLUTANTS AND SYSTEMS OF PURIFICATION [English summary]
Beccali, G., and G. Panno. 1975.
Atti della Accademia di Scienze, Lettere e Arti di Palermo, Parte I. 34(1):63-103.

Refineries, Wastewater treatment, Pollution control, *Purification

"A review with 17 references."

[from Chemical Abstracts 85(20):#148383c. 1976]

C-0152-77
PREVENTION OF WATER POLLUTION IN THE PETROCHEMICAL INDUSTRY-CURRENT SITUATION AND FUTURE VIEWS
Benedetti, L., A. Scarfi, and A. Vandi. 1975.
Pure and Applied Chemistry 45(3/4):147-151.

Pollution prevention, Wastewater treatment, Industries, Petrochemicals, Socio-economic effects, Economics, Legislation

Environmental problems faced by the petrochemical industry in recent years are briefly assessed. A solution to these problems will require careful evaluation of socio-economic factors such as public opinion, cost/benefit analyses and legislative constraints, and the development of new and more effective pollution abatement technology.

C-0153-77
EFFECT OF SEDIMENT ORGANIC MATTER ON MIGRATION OF VARIOUS CHEMICAL CONSTITUENTS DURING DISPOSAL OF DREDGED MATERIAL
Blom, B. E., T. F. Jenkins, D. C. Leggett, and R. P. Murrmann. 1976.
Final report on Dredged Material Research Program, WES-CR-D-76-7. 183p.

Disposal, *Organic wastes, Water quality, Chemical analysis, Sediments, Seawater, Freshwater, Hydrocarbons

The experimental work was directed toward identifying the role that sediment organic carbon has in controlling various water quality parameters at disposal sites. Both sediment organic carbon and soluble organic matter were generally found to have no demonstrable effect on water quality. Exceptions to this conclusion were found in two sediments containing significant amounts of petroleum hydrocarbons.

[from Government Reports Announcements 76(20):#AD-A027 394/6GA. 1976]

C-0154-77
ACTIVE AND PASSIVE ENVIRONMENTAL CONTROL VIA SEPARATING REACTIONS
Boelsing, F. 1975.
Chemistry and Industry 27(7):406-408.

Waste oil treatment, Wastewater treatment, Oil-water separation

The use of chemicals that produce an enlarged surface after reacting with other materials are discussed as a means for eliminating oily wastes and residues, and for separating oil from wastewater.

[from Environmental Health and Pollution Control 10(5):#1170. 1976]

C-0155-77
FIGHTING SURFACE WATER POLLUTION AT THE ESSO REFINERY IN ANTWERP
Bossuyt, L. 1976.
Ingenieursblad 45(2):41-49.

Refineries, Wastewaters, Pollution control, Belgium

Principles of the purification and pollution control systems of a Belgian refinery are described.

[from Chemical Abstracts 85(18):#129999s. 1976]

C-0156-77
CATIONIC POLYMERS FOR BREAKING OIL-IN-WATER EMULSIONS
Bradley, R. L., A. J. Sadowski, and E. G. Ballweber. 1976.
U.S. Patent 3,956,117

Wastewater treatment, Emulsions, Oil-water separation, *Cationic polymers

Oil-in-water emulsions are treated with a polycationic water-soluble ionene polymer which is prepared from trans-1,4-dichloro-2-butene and dimethylamine with or without ethylenediamine.

[from Chemical Abstracts 85(12):#79301k. 1976]

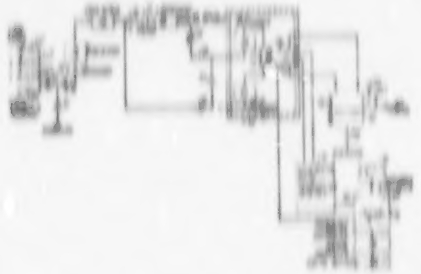
C-0157-77
OIL DETECTION SYSTEM
Cirulis, U., and E. M. Zacharias. 1976.
U.S. Patent 3,892,127

Wastewater treatment, Oil-water separation, Detection, Contamination, Design and engineering

"An improved separating means for the oil contained in a flowing stream of contaminated water."

[from Environmental Technology and Economics 10:6. 1976]

3,892,127
OIL DETECTION SYSTEM
Uldis Cirulis, Midland Park, and Ellis M. Zacharias, Jr., Ridgewood, both of N.J., assignors to Nusonics, Inc., Paramus, N.J.
Filed July 27, 1973, Ser. No. 383,408
Int. Cl. G01n 29/02
U.S. Cl. 73—61.1 R 20 Claims



C-0158-77
CUT WASTEWATER TREATMENT COSTS
Crame, L. W. 1976.
Hydrocarbon Processing 55(5):92-94.

Refineries, Wastewater treatment, Oxidation, Economics, Petrochemicals

"Treatment of oil refinery effluent using rotating disc bio-oxidation equipment saved money over the options examined while producing a satisfactory effluent. Energy consumption [was] also reduced over activated sludge or aerated lagoon treatment."

[from Industrial Wastes Information Bulletin 7(3):#HMS 6813. 1976]

C-0159-77
PROCESS FOR REMOVING HYDROCARBONS FROM WASTE WATERS
Creusot-Loire. 1976.
British Patent 1,420,288

Wastewater treatment, Oil-water separation, Hydrocarbons, *Solvent extraction

Effluent containing hydrocarbons is passed through a column of bentonite (or other inert inorganic material) -amine complex and after solvent extraction produces a final effluent with less than 5 ppm hydrocarbons.

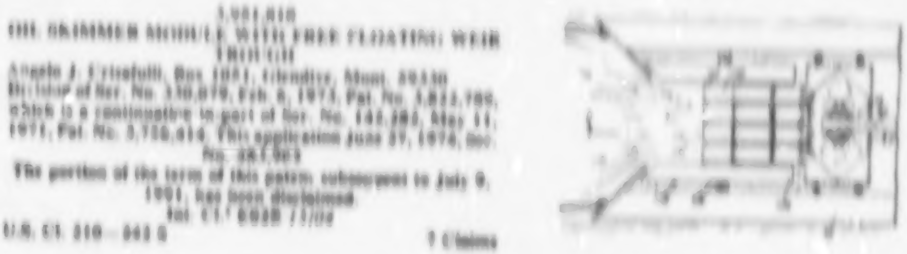
[from Industrial Wastes Information Bulletin 7(4):#HMS 7476. 1976]

C-0160-77
OIL SKIMMER MODULE WITH FREE FLOATING WEIR TROUGH
Crisafulli, A. J. 1976.
U.S. Patent 3,951,010

Oil-water separation, Oil spills, Skimmers, Design and engineering

An oil-water mixture is collected into a sump box via gravity flow, separated, and the water is then discharged. A weir placed in the opening in the sump box controls the quantity of water and oil discharged into the box.

[from Selected Water Resources Abstracts 9(19):#W76-10482. 1976]



3,951,010
OIL SKIMMER MODULE WITH FREE FLOATING WEIR TROUGH

7 Claims

C-0161-77
WASTE TREATMENT PLANTS
Davies, R. J., and D. G. Blows. 1976.
U.S. Patent 3,954,605

Waste oil treatment, Fuel oil, *Solid wastes, *Sewage, Disposal, Incineration

Wastes including sewage, solid wastes and waste fuel oils are processed into a combustible form and then incinerated with waste fuel oil and sewage solids to yield deodorized waste gases, incombustible ash, and disinfected wastewater.

[from Chemical Abstracts 85(20):#148720k. 1976]

C-0162-77
WASTE MANAGEMENT PAPER NO. 7 MINERAL OIL WASTES
Department of the Environment. 1976.
Her Majesty's Stationery Office, Report ISBN--0-11-751060-2, 32p.

Waste oil treatment, Waste oil disposal, Lubricating oil, Environmental effects, Reclamation

The nature and environmental effects of wastes arising from the production and use of oils, especially lubricating oils, are reviewed. Present practices and possible future changes in the treatment, disposal, and recovery of such wastes are discussed.

[from Industrial Wastes Information Bulletin 7(3):#HMS 6909. 1976]

C-0163-77
STEPS IN THE TECHNIQUE OF TREATMENT OF WASTE WATER IN THE PETROLEUM INDUSTRY [English summary]
Derenk, G. 1975.
Erdoel und Kohle, Erdgas, Petrochemie 28(5):246.

Wastewater treatment, Petrochemicals, Oil industry, Oil-water separation, Oxidation, Incineration, Flotation, Filtration, Adsorption

Principal methods for treating petrochemical and petroleum industry wastewaters are briefly discussed, including stripping, separation, flotation, biological oxidation, adsorption, extraction, filtration and incineration.

[from Environmental Health and Pollution Control 10(5):#1169. 1976]

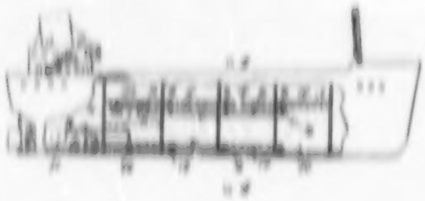
C-0164-77
SHIP BALLAST, OIL AND WATER SEPARATION SYSTEM
Di Perna, J. 1976.
U.S. Patent 3,957,009

Wastewater treatment, Ships, Oil-water separation, Ballast, Pollution control, Tankers, Design and engineering

A comprehensive shipboard system is described for separating floating oil from ballast water, holding the oil in an oil collection unit, and then transferring the oil through a network of pipes into a central storage and holding tank.

[from Selected Water Resources Abstracts 9(22):#W76-11827. 1976]

3,957,009
SHIP BALLAST, OIL AND WATER SEPARATION SYSTEM
James Di Perna, 85 Foxhill Terrace, Staten Island, N.Y. 10305
Filed Oct. 15, 1974, Ser. No. 517,897
Int. Cl.² B63B [illegible]
U.S. Cl. 114—74 R 5 Claims



C-0165-77
ELECTROLYTIC TREATMENT OF OILY WASTEWATER. LABORATORY INVESTIGATION
Dziechuch, M. A., M. H. Weintraub, and R. L. Gealer. 1976.
Electrochemical Society Extended Abstract 76-1:647-649.

Wastewater treatment, Oil-water separation, Coagulation, Oxidation, Sludge

"Under continuous flow conditions laboratory tests showed electrolytic introduction of ferrous iron as coagulant followed by in situ oxidation gave a sludge of much lower water content than that obtained from conventional ferric iron treatment."

[from Industrial Wastes Information Bulletin 7(3):#HMS 6805. 1976]

C-0166-77
PROCESS FOR SEPARATING OIL FROM EMULSIONS OF OIL IN WATER
Gasser, A. 1976.
U.S. Patent 3,931,005

Wastewater treatment, Emulsions, Oil-water separation, pH control

"Efficient and economic separation is achieved by adding ferric sulphate or chloride, used oil; alkali sufficient to give a pH of 5.5-6.5 are added to oil/water emulsion and allowed to stand. Oil free water is drawn off."

[from Industrial Wastes Information Bulletin 7(3):#HMS o815, 1976]

3,931,005
PROCESS FOR SEPARATING OIL FROM EMULSIONS OF OIL IN WATER
Adolf Gasser, 9495 Triesen, Liechtenstein
Continuation of Ser. No. 164,872, July 26, 1971, abandoned, which is a continuation of Ser. No. 827,387, May 23, 1969, abandoned. This application Aug. 31, 1973, Ser. No. 393,682
Claims priority, application Austria, May 27, 1968, 5063/68
Int. Cl.² B01D 17/04
U.S. Cl. 210—43 16 Claims

C-0167-77
TREATMENT OF CHEMICAL AND MECHANICAL DIESEL OIL-WATER EMULSIONS BY ULTRAFILTRATION MEMBRANES
Gollan, A., D. Grant, and R. L. Goldsmith. 1975.
American Society of Mechanical Engineers Meeting, 1975. Paper N75-ENAs-57. 9p.

Wastewater treatment, Emulsions, Oil-water separation, *Ultrafiltration membranes

This paper describes results from a study in which two commercially available ultrafiltration membranes, Abcor Inc. Type HFA (cellulosic) and HFD (noncellulosic), were tested for the treatment of oily water emulsions containing diesel oil, nonionic detergent, and fine sand particles. The HFA membrane exhibited superior permeate quality, yielding less than 10 ppm oil in all cases.

[from MRIS Abstracts Vol. 13:#14 134205. 1976]

C-0168-77
CLARIFYING OILY WATER MIXTURES
Goodrich, R. R., and E. R. Corino. 1976.
U.S. Patent 3,948,770

Wastewater treatment, Emulsions, Tankers, Oil-water separation, Flocculation

Finely dispersed oil in seawater, such as in slop tanks of oil tankers, can be rapidly separated by addition of a dry flocculant composition consisting of one part anionic acrylamide copolymer-based polyelectrolyte and ~ 200 parts Na or Ca montmorillonite.

[from Chemical Abstracts 85(13):#98708r. 1976]

C-0169-77
USE OF POLYELECTROLYTES IN TREATING OIL-CONTAMINATED INDUSTRIAL WASTEWATER
Gudasheva, V. M., and L. V. Verkhotina. 1975.
Chemistry and Technology of Fuels and Oils 11(9-10):706-709.

Wastewater treatment, Industries, Contaminants, Flocculation, *Polyelectrolytes

Cationic polyelectrolytes were used as flocculants for purification of industrial effluents containing petroleum impurities. Physicochemical treatment was demonstrated to be effective in treating oily industrial wastewaters.

[from The Engineering Index Monthly 14(9):#060615. 1976]

C-0170-77
CLEANING OF CARGO COMPARTMENTS
Gutnick, D., and E. Rosenberg. 1976.
U.S. Patent 3,941,692

Wastewater treatment, Waste oil treatment, Ballast, Tankers, Biodegradation

A procedure is described for cleaning oil tanker compartments and ballast waters and converting the waste petroleum oils and residues into useful, non-oily protein products by microbial conversion. The process consists of adding nitrogen, phosphorus, and small amounts of carbohydrates to sea water and washing the compartments under aerobic conditions with this mixture.

[from Selected Water Resources Abstracts 9(16):#W76-08190. 1976]

C-0171-77
ASSEMBLY AND TESTING OF THE MARK I SHIPBOARD SEPARATOR SYSTEM
Guzdar, A. R., A. C. Harvey, and W. M. Mack. 1975.
Final report, USCG-D-18-76; Contract DOT-CG-24287-A. 67p.

Oil-water separation, Bilges, Ships, Wastewater treatment

The system is composed of a skid mounted separator module and a control console; it is designed to process ships' bilge water at a rate of 180 l/min (50 gal/min) and provide water effluent containing less than 15 ppm oil. Test results indicate that the system is capable of continuously processing bilge waters containing up to 20% No. 2 fuel oil and discharging water effluent with less than 7 ppm oil.

[from Government Reports Announcements 76(17):#AD-A025 948/1GA. 1976]

C-0172-77
SPECIAL ISSUE: STUDIES ON INDUSTRIAL POLLUTED WATER TREATMENT. PRACTICAL TREATMENT TECHNIQUES FOR OIL POLLUTION
Hagiwara, K. 1976.
PPM 7(5):18-30.

Wastewater treatment, Waste oil treatment, Pollution control

"A review with 21 references."

[from Chemical Abstracts 85(20):#148382b. 1976]

C-0173-77
APPARATUS FOR SEPARATING OIL FROM WATER
Harris, F. R., and C. Gerardus. 1976.
Austrian Patent 327,831

Wastewater treatment, Oil-water separation, Emulsions, Design and engineering

The apparatus consists of a reservoir through which the oil-water mixture is passed continuously and two sloping, parallel plates over which the oil-water mixture is forced to pass. The plates help to eliminatr turbulence and thereby help to effect oil-water separation.

[from Chemical Abstracts 25(10):#67815t. 1976]

C-0174-77
EXPANDING POLLUTION CONTROL IN AN EXISTING PLANT
Heim, P. 1974.
International Pollution Engineering Congress and Exposition, 3rd, Chicago. New York, Clapp and Poliak, 1974. p.67-77.

Oil-water separation, Wastewater treatment, Emulsions, Skimmers, Economics

"Case history including survey of effluents, planning, design of system to treat effluent containing emulsified and free oil, chrome, suspended solids, using acid cracking, oil skimming and neutralisation. Operating problems, costs included."

[from Industrial Wastes Information Bulletin 7(4):#HMS 7541. 1976]

C-0175-77
INDUSTRIAL WASTES. PETROLEUM PROCESSING WASTES
Hornung, W. L., and D. A. Baker. 1976.
Journal of Water Pollution Control Federation 48(6):1293-1295.

Wastewater treatment, Refineries, Petroleum products

"A review with 27 references of the treatment of waste from petroleum processing."

[from Chemical Abstracts 85(20):#148371x. 1976]

C-0176-77
REMOVAL OF OIL FROM AN OIL-IN-WATER EMULSION
Imperial Chemical Industries Ltd. 1975.
Netherlands Application 75 02,731

Wastewater treatment, Emulsions, Oil-water separation

Oil was removed from an oil-water emulsion with the use of hydrophobic textile materials which were prepared from poly(ethylene terephthalate) fibers, surrounded by a poly(ethylene adipate terephthalate) mantle, and coated by silane-treated SiO_2.

[from Chemical Abstracts 85(12):#82907t. 1976]

C-0177-77
PURIFICATION OF PETROLEUM-AND PHENOL-CONTAINING WATERS BY AN ELECTRICAL TREATMENT PROCESS [in Russian]
Ivanova, L. G., V. D. Sidorenko, I. A. Udovenko, and L. V. Kuchmii. 1976.
Zhurnal Prikladnoi Khimii (Leningrad) 49(2):424-430.

Wastewater treatment, Oil-water separation, Refineries, USSR

Wastewater from a Kherson petroleum plant was purified by electrolysis. Treatment was conducted in a laboratory unit which consisted of a reactor and electrodes, and was supplemented in dynamic conditions by a cooler, separation funnel, and a collector for purified water. The concentration of petroleum hydrocarbons and phenols in the wastewater was decreased to 0.2-1.29 mg/l and 0.01 mg/l, respectively.

[from Chemical Abstracts 85(12):#82759w. 1976]

C-0178-77
WASTE WATER TREATING SYSTEM FOR PETROLEUM REFINERIES [in Japanese]
Iawsaki, M., and M. Ito. 1975.
Yosui To Haisui 17(7):831-839.

Wastewater treatment, Refineries, Adsorption

Discussed is the treatment of wastewaters, including oily effluents, from petroleum refineries, with emphasis on closed wastewater treatment systems. Final treatment involves adsorption on activated carbon.

[from Chemical Abstracts 85(18):#129930n. 1976]

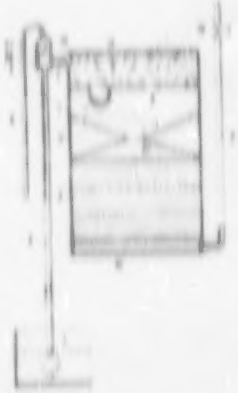
C-0179-77
DEVICE FOR SEPARATING LIQUIDS OF SPECIFICALLY LOWER DENSITY THAN WATER, AND PARTICULARLY OIL, FROM WATER
Jakubek, P., and K. Biswanger. 1976.
U.S. Patent 3,957,641

Oil-water separation, Waste oil, Bilges, Design and engineering

A device for separating oil from bilge water is described. The device consists basically of a pump and a separator composed of a settling chamber and filter pack. Bilge water is pumped into the settling chamber, and an overflow opening with shutoff valve beyond the filter prevents oil from exiting with the purified water.

[from Selected Water Resources Abstracts 9(22):#W76-11836, 1976]

3,957,641
DEVICE FOR SEPARATING LIQUIDS OF SPECIFICALLY LOWER DENSITY THAN WATER, AND PARTICULARLY OIL, FROM WATER
Peter Jakubek, Brunn am Gebirge, and Kurt Binnenger, Vienna, both of Austria, assignors to Fa. Euro Pollution Control Systems, Inc., Luxemburg, Luxemburg
Filed May 16, 1974, Ser. No. 469,894
Claims priority, application Austria, May 16, 1973, 4282/73
Int. Cl.² B01D 17/00
U.S. Cl. 210—130 **6 Claims**



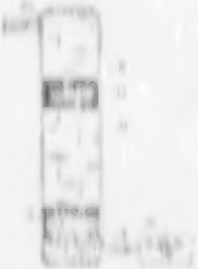
C-3180-77
REMOVING OIL FROM WASTE WATER WITH SULFUR
Jones, L. W. 1976.
U.S. Patent 3,957,647

Wastewater treatment, Oil-water separation, Dispersions, Coalescence, *Sulfur

Dispersed oil is removed from water by contacting the oily water with sulfur which causes the oil to coalesce or agglomerate. The sulfur can be added to water in the form of a slurry, or the water may be passed through a porous bed of granular sulfur or sulfur-coated sand.

[from Selected Water Resources Abstracts 9(22):#W76-11838, 1976]

3,957,647
REMOVING OIL FROM WASTE WATER WITH SULFUR
Loyd W. Jones, Tulsa, Okla., assignor to Amoco Production Company, Tulsa, Okla.
Division of Ser. No. 81,124, Oct. 13, 1970, Pat. No. 3,853,753.
This application Sept. 7, 1974, Ser. No. 502,718
The portion of the term of this patent subsequent to Dec. 29, 1991, has been disclaimed.
Int. Cl.² B01D 17/04
U.S. Cl. 210—365 **10 Claims**



C-0181-77
CYLINDRICAL FIBROUS ADSORBERS FOR OIL SEPARATION
Kita, S., and T. Kono. 1976.
Japanese Kokai (unexamined patent application) 76 20,087

Wastewater treatment, Oil-water separation, Adsorption

The adsorber, composed of fibers wound concentrically or spirally around a porous core, effectively removes oil from air or water.

[from Chemical Abstracts 85(12):#82956h. 1976]

C-0182-77
REMOVAL OF EMULSIFIED OIL FROM WASTE WATER
Kita, S., and T. Kono. 1976.
Japanese Kokai (unexamined patent application) 76 85,267

Wastewater treatment, Emulsions, Oil-water separation, Flocculation, Adsorption

Emulsified oil is removed from wastewater by admixing alum and a polymer flocculant, and then contacting the mixture with an oil adsorbent.

[from Chemical Abstracts 85(20):#148707m. 1976]

C-0183-77
REMOVAL OF PETROLEUM PRODUCTS AND HEAVY METAL IONS FROM WASTE WATERS
Kordakov, I. A., and Zh. N. Obukhovskaya. 1976.
USSR Patent 510,438

Wastewater treatment, Recovery, Petroleum products, Contaminants

"For increasing the degree of removal of petroleum products and Cu and Zn ions, and for reducing the cost of the process, waste waters are treated with siltstone with the ratio of siltstone and petroleum products 10:1-3:1."

[from Chemical Abstracts 85(14):#98802r. 1976]

C-0184-77
REMOVAL OF PETROLEUM PRODUCTS FROM WASTE WATERS BY OXIDATION WITH OZONE
Kukhen, B. L., F. M. Git, and N. F. Reznik. 1976.
USSR Patent 513,013

Wastewater treatment, Petroleum products, Oxidation, Filtration

Wastewaters are treated with 60-70% of the ozone, the resultant oxidized petroleum products are removed, and the filtrate is treated with the remaining ozone.

[from Chemical Abstracts 85(16):#122 474u. 1976]

C-0185-77
TANKER SLUDGE REMOVAL AND DISPOSAL
Lanotte, V. X., and J. E. Shewmaker. 1976.
Final report on Task 2, EII.11TMR.76, MA-RA-RD-940-76055.
Contract C-5-38000. 51p.

Tankers, Sludge, Disposal, Crude oil, Guidelines

A general description is given of the problem of cargo tank sludge on crude carriers, and sludge management alternatives used in selecting a strategy are scanned. Crude washing is discussed as a combined removal and disposal technique. Current and potential shore disposal methods include sludge farming, incineration, oil extraction, chemical fixation, and aqueous extraction.

[from Government Reports Announcements 76(19):#PB-255 174/5GA. 1976]

C-0186-77
GRANULAR PACKED BED COALESCER: INFLUENCE OF PACKING WETTABILITY ON COALESCENCE
Madia, J. R., S. M. Fruh, C. A. Miller, and A. Beerbower. 1976.
Environmental Science and Technology 10(10):1044-1046.

Wastewater treatment, Oil-water separation, Coalescence, *Oil wettability

Beds of granular material are used to remove small oil drops from aqueous effluent streams. Experiments performed show that oil removal ability increases with increasing oil wettability of bed material. XAD-2, a copolymer of styrene and divinylbenzene, is noted to be especially effective in oil removal.

C-0187-77

OIL EXTRACTOR

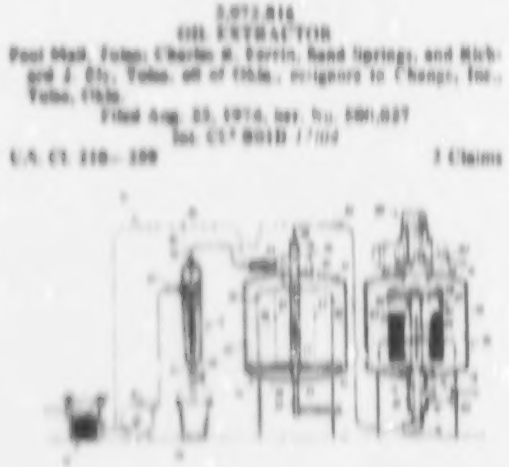
Mail, P., C. R. Ferrin, and R. J. Ely. 1976.

U.S. Patent 3,972,816

Wastewater treatment, Oil-water separation, Coalescence, Emulsions, Design and engineering

An oil-water separator is described that uses a demulsifier for coalescing the emulsified oil into droplets large enough for processing in a separator. A centrifuge is also attached for the removal of any large solids in the oil-water mixture.

[from Petroleum Abstracts 16(46):#226,934. 1976]



C-0188-77

STUDIES OF DETERGENT SYSTEMS USEFUL IN TREATMENT OF BILGE WATER AND OTHER SEWAGE DISPOSAL SYSTEMS

Massie, S. P. 1976.

Final report July-August 1975, USNA-EPRD-23. 18p.

Wastewater treatment, Bilges, Emulsions, Analytical techniques, Spectroscopy, Fuel oil, Lubricating oil

Ultraviolet spectroscopy has been used to study systems of a non-ionic detergent in synthetic seawater and in cyclohexane, and mixtures of the detergent with a fuel oil and two lubricating oils in cyclohexane and in synthetic seawater. In the oil/detergent mixed solutions, absorbance of oil and detergent were not quantitatively additive. Thus, the detergent could not be quantitatively determined in the presence of the oils.

[from Government Reports Announcements 76(20):#AD-A027 418/3GA. 1976]

C-0189-77
DISPOSAL PROBLEMS AT DRILLING LOCATIONS
McDaniel, K. W. 1976.
Society of Petroleum Engineers of AIME, Rocky Mountain Regional
Meeting, 1976. SPE 5900. 4p.

Drilling, *Waste materials, Disposal

Recommended measures for waste disposal and the minimization of spills around drilling locations are outlined. Details relating to drilling mud, mud pits, and cuttings are listed. Levees should be properly maintained and ditching must be provided to carry waste mud from the rig to the reserve pit. Each drilling site should have a disposal pit or other suitable warte receptable for all waste materials produced.

[from Pollution Abstracts 7(5):#76-04971. 1976]

C-0190-77
DEVELOPMENT OF AN ADVANCED CAPABILITY FOR TESTING SHIPBOARD OIL CONTENT METERS
Mitchell, C. E. 1975.
Society of Naval Architects and Marine Engineers, Gulf Meeting,
1975. 38p.

Oil discharges, Ships, Pollution prevention, *Testing, *Oil content meters

This presentation concerns the National Maritime Research Center's program on the abatement of pollution from ship oily waste discharges. The program was designed to identify the nature and degree of the problem and direct test and evaluation activities towards systems developed by industry to solve the program. Technical approaches to meeting program objectives are outlined.

[from MRIS Abstracts Vol. 13:#14 131868. 1976]

C-0191-77
ENVIRONMENTAL POLLUTION DUE TO PETROLEUM INDUSTRY
Mony, G. S. 1975.
Journal of the Institute of Engineers (India), Part CH 56(1):
26-29.

Wastewater disposal, Oil fields, Refineries, Environmental effects, Oil industry

"A review with 4 references of waste disposal in the oilfields and refineries and their effect on the environment."

[from Chemical Abstracts 85(16):#112326. 1976]

C-0192-77
THE FINAL PURIFICATION OF THE EFFLUENTS FROM A PETROLEUM REFINERY
Mortola, G., and A. Alexanian. 1975.
ICP 3(9):117-120.

Wastewater treatment, Refineries, Flocculation, pH control, Sedimentation

"The final purification of the effluent from a petroleum refinery is advantageously obtained by flocculation with Fe salts, adjusting the pH with lime or sodium hydroxide and subsequent separation with an ascendant flow sludge bed SECLAR sedimentator."

[from Chemical Abstracts 85(16):#112 368n. 1976]

C-0193-77
APPARATUS AND METHOD FOR THE TREATMENT OF WASTE WATER WHICH CONTAINS COMBUSTIBLE ORGANIC IMPURITIES
Noda, M., K. Nomura, Y. Kawase, and A. Iwasa. 1976.
German Offenlegungsschriften (unexamined patent application) 2,549,082

Wastewater treatment, Emulsions, Oil-water separation, Filtration, Incineration, Fuel oil

Wastewaters containing emulsified oil are first treated by ultrafiltration to remove most of the oil, then the filtrate is passed through a reverse osmosis unit to remove the remaining oil. The separated oil is fired as fuel, and the resultant hot gases are used to decompose other organic matter in the wastewater.

[from Chemical Abstracts 85(20):#146616 f. 1976]

C-0194-77
FLUIDIC OIL-WATER SEPARATOR
Paszyc, A. J., D. Pal, and J. B. Curry. 1976.
U.S. Patent 3,972,814

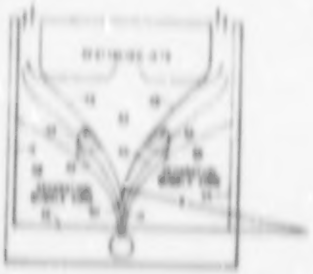
Wastewater treatment, Oil-water separation, Design and engineering, *Coanda effect

An oil-water separating method and apparatus based on the Coanda effect for separating oil from an oil-water mixture is described.

The mixture enters the housing, is split into 2 subjets, and each subjet separates the oil from water.

[from Petroleum Abstracts 16(46):#226,933. 1976]

3,971,814
FLUIDIC OIL-WATER SEPARATOR
Abbey J. Pesce, Ventura; Dharam Pal, Woodland Hills, and John W. Curry, Oxnard, all of Calif., assignors to The United States of America as represented by the Secretary of the Navy, Washington, D.C.
Filed Feb. 18, 1975, Ser. No. 549,848
Int. Cl.² B01D 21/26
U.S. Cl. 210—84 13 Claims



C-0195-77
SOLVING THE WASTE WATER PROBLEMS IN LUBRICATION TECHNOLOGY [in German]
Rueb, F. 1975.
Schmiertechnik und Tribologie 22(3):56-59.

Wastewater treatment, Emulsions, Lubricating oil, Oil-water separation, Flocculation, Filtration

Wastewater problems involving the treatment of residual grease, oil, and emulsions are discussed, and four treatment methods are described: emulsion separation using special agents; addition of salts, acids, or flocculants; thermal treatment using vaporization; and ultrafiltration treatment.

[from Environmental Health and Pollution Control 10(5):#1168. 1976]

C-0196-77
REMOVAL OF EMULSIFIED OIL FROM WASTE WATER
Sato, H., M. Arita, S. Fujii, and T. Kakuda. 1974.
Japanese Kokai (unexamined patent application) 76 38,722

Wastewater treatment, Emulsions, Filtration, Oil-water separation

Filtration of oily wastewater through a packed layer consisting of a fibrous organic polymer, such as polyethylene terephthalate, and inorganic particles with high oil removability results in effective oil-water separation.

[from Chemical Abstracts 85(20):#148575s. 1976]

C-0197-77

TREATMENT OF WASTE WATER FROM AN OIL REFINERY

Saito, R. 1976.
Japanese Kokai (unexamined patent application) 76 15,563

Wastewater treatment, Refineries, Oxidation, pH control, Flocculation, Flotation

Oily wastewater containing alkaline and reducing materials is purified by blowing Cl_2 into the water to oxidize the reducing material, neutralizing, adding $FeCl_2$, neutralizing again, and finally separating the suspended solids by flotation.

[from Chemical Abstracts 85(20):#148595y. 1976]

C-0198-77

TREATMENT OF WASTE WATER FROM AN OIL REFINERY

Saito, R. 1976.
Japanese Kokai (unexamined patent application) 76 15,564

Wastewater treatment, Refineries, Oil-water separation, pH control, Oxidation, Flocculation

"A waste water containing reducing material, alkaline material, PhOH, and mineral oil is oxidized by hypochlorite and mixed with a ferrous salt, followed by pH adjustment to a weak alkaline condition and separating the resulting suspended materials."

[from Chemical Abstracts 85(20):#148594x. 1976]

C-0199-77

POLLUTION (AIR AND WATER) CONTROL AND RECOVERY OF SULFUR IN PETROLEUM REFINERIES

Shanmugasundaram, S., A. Shariat, and V. Pachaiyappan. 1976.
Chemical Age India 27(4):357-365.

Wastewater treatment, Refineries, Pollution control

"A review with 20 references of the treatment of gaseous liquid and solid wastes from a petroleum refinery and the recovery of S and SO_2 from the wastes."

[from Chemical Abstracts 85(20):#148356w. 1976]

C-0200-77
CHARACTERIZATION OF PRODUCT TANKER SLOP WATERS
Shewmaker, J. E. 1976.
Final report on Task 4, EE.10TMR.76, MA-RD-930-76054.
Contract D-5-3800. 55p.

Tankers, Bilges, Wastewater treatment, *Characterization studies, Fuels

The title study was conducted to provide basic data for planning shore-based reception and treatment facilities for the wastewaters. Among the products transported by vessels in the study were gasolines, diesel fuels, heating oils, fuel oils, kerosine, and aromatic naphthas and solvents. Oil was found to be the principal contaminant. The pollutants in tanker wastewaters could be handled in existing treating processes at most locations.

[from Government Reports Announcements 76(19):#PB-254 987/1GA. 1976]

C-0201-77
REGULATIONS OF ONSHORE AND OFFSHORE OIL FIELD WASTE DISPOSAL
Smith, J. E. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, 1975. p.579-584. Proceedings.

Waste oil disposal, Oil fields, Regulations, State governments, Texas

The Texas Railroad Commission, a state agency, is responsible for waste disposal including wastes [illegible] oil and gas operations on state lands and state waters. The exercise of these responsibilities is authorized by general statutes, statewide rules, and special orders.

[from Selected Water Resources Abstracts 9(17):#W76-0819. 1976]

C-0202-77
TREATMENT OF WASTE WATER RESULTING FROM PETROLEUM CRACKING INSTALLATIONS
Stamicarbon, B. V. 1975.
Netherlands Application 74 06,871

Wastewater treatment, Refineries, Hydrocarbons, Petroleum products

Hydrocarbon mixtures such as C_6 raffinate from gasoline production can be used to remove oils or cracking products from the refinery wastewater. The raffinate is recovered by stripping with air and is recycled.

[from Chemical Abstracts 85(20):#148578v. 1976]

C-0203-77
PURIFICATION OF WASTE WATERS
Standard Oil Company (Indiana). 1975.
Belgian Patent 829,025

Wastewater treatment, Refineries, Oil-water separation

Mixed refinery and petrochemical plant wastewaters are treated in an API primary separator to remove oils and solids, then neutralized, coagulated, oxidized and filtered. Activated sludge treatment followed by aeration and optional tertiary treatment are the final steps in this purification process.

[from Chemical Abstracts 85(16):#112481u. 1976]

C-0204-77
SEPARATING PETROLEUM PRODUCTS FROM THE SURFACE OF SOLIDS OR LIQUIDS
Stein, C., and A. Marbach. 1976.
German Offenlegungsschriften (unexamined patent application) 2,547,742

Oil-water separation, Petroleum products, Adsorption, *Skimming

"Hydrocarbon oils are adsorbed by 10-16% of their weight of the polymers formed by opening the ring of bicyclo[2.2.1]hept-2-ene or of its Me derivative." The resultant cohesive floating film is removable by skimming.

[from Chemical Abstracts 85(18):#126878r. 1976]

C-0205-77
TREATMENT OF OIL-WATER EMULSIONS
Tanaka, K. 1976.
Japanese Kokai (unexamined patent application) 76 55,158

Wastewater treatment, Oil-water separation, Emulsions, Coagulation, Flocculation, Filtration

Oil is coagulated when nitrohumic acid and/or an organic base is added to an oil-water emulsion and the pH is adjusted to 2-7. The resultant oil flocs are filtered out.

[from Chemical Abstracts 85(20):#148658w. 1976]

C-0206-77
TREATMENT OF OIL-CONTAINING WASTE WATER
Tanaka, K., and K. Usui. 1976.
Japanese Kokai (unexamined patent application) 76 49,556

Wastewater treatment, Oil-water separation, Filtration, pH control

Oily wastewater is mixed with thiolignin, acidified to pH < 7, agitated, and then filtered to remove oil.

[from Chemical Abstracts 85(20):#148599c. 1976]

C-0207-77
CLEAN WATER. REPORT TO CONGRESS, 1974
U.S. Environmental Protection Agency. 1974.
Environmental Protection Agency report. 90p.

Water quality, Wastewater treatment, Industries, Regulations, *Oil pollution, *Sewage

Contents include: role of government, industry, and the public; Water quality, monitoring and planning; Grants to state and local governments; Regulation; Water quality standards and effluent limitations; Research and development; Efficiency of treatment works.

[from Government Reports Announcements 76(19):#PB-254 622/4GA. 1976]

C-0208-77
SEPARATION OF OIL FROM WASTE EMULSIFIED OIL
Wakabayashi, Y., and H. Takada. 1976.
Japanese Kokai (unexamined patent application) 76 30,585

Waste oil treatment, Emulsions, Oil-water separation

A polymer flocculant is added to a powdered mixture containing $CaCl_2$ - impregnated pozzolan 60 and polyaluminum chloride to produce an oil-water separating agent for waste emulsified oil.

[from Chemical Abstracts 85(17):#82959m. 1976]

C-0209-77
ELECTROLYTIC TREATMENT OF OILY WASTEWATER - ENGINEERING DEVELOPMENT
Weintraub, M. H., M. A. Dzieciuch, and R. L. Gealer. 1976.
Electrochemical Society Extended Abstract 76-1:650-651.

Wastewater treatment, Emulsions, Oil-water separation, Coagulation

"A description [is given] of the design and performance of an electrolytic cell for producing ferrous iron which, on oxidation, acts as an emulsion breaker and coagulant of superior performance to ferric iron."

[from Industrial Wastes Information Bulletin 7(3):#HMS 6805. 1976]

5. RECLAMATION AND REUSE

C-0210-77
DOWN THE DRAIN - STILL
Anon. 1976.
Environmental Action 8(8):7-8.

Waste oil, Disposal, Recycling, Reuse, Guidelines, Legislation

The safe disposal of nearly 4 billion liters (over 1 billion gallons) of waste oil per year in the U.S. alone remains a major problem. Effective recycling programs, tax policies favoring the reuse of oil, and educating the public would greatly relieve this pollution problem. New literature which addresses the recycling of waste oil and legislative guidelines are pointed out.

C-0211-77
OIL RECLAMATION SYSTEM (product information)
Anon. 1976.
Chemical Engineering 83(23):162.

Reclamation, Waste oils, Design and engineering

The Petro-Clar Model PI-1000-2 dehydrates and filters a range of industrial oils at flow rates to 454 l/hr (120 gal/hr). Contaminated oil is heated and passed into a vacuum vessel where disperser elements filter out solids and promote vaporization of any entrained water. FFI contact Velcon Filters Inc., 1750 Rogers Ave., San Jose, CA 95112.

C-0212-77
SEPARATING OIL FROM WATER
Anon. 1976.
Processing 22(5):12-13.

Oil-water separation, Wastewaters, Waste oil, Reclamation, Reuse

Several companies have developed equipment for oily water separation by a variety of processes which are briefly described. The methods are designed for the recovery and reuse of process waters and the reclamation of waste oil.

C-0213-77
THE REGENERATION OF THE SPENT OILS [English summary]
Audibert, M. M., T. Bonneford, Dan Vu Quang, and A. Vidal. 1976.
La Chimica E. L'Industria 58(5):339-343.

Reclamation, Waste oil, Lubricating oil, Fuel oil, Crankcase oil

The numerous sources of waste petroleum-based oils that can be reclaimed are briefly considered, and the general chemical characteristics of spent oils are tabulated. Processes for reclaiming spent oil, are compared, with emphasis on the advantages - efficiency and low pollution - of the selectopropane extraction process for removing asphaltic and metallic residues from used oils.

C-0214-77
RECYCLED OIL
Becker, D. A., and J. D. Hoffman. 1976.
Science 194(4264):478.

Waste oil treatment, Recycling, Fuel oils, Lubricating oils, Legislation, U.S.

Under the Energy Policy and Conservation Act of 1975 (Public Law 94-163), the National Bureau of Standards (NBS) is to "develop test procedures for determination of substantial equivalency of re-refined or otherwise processed used oil... with new oil for a particular end use." This law not only covers lubricating oils, but also industrial oils, metal working oils, hydraulic oils, oils used for fuel, and engine oils.

C-0215-77
RE-REFINING/RECYCLING OF ENGINE OILS
Bhargava, M. K. 1975.
Chemical and Petro-Chemical Journal 8(11):3-11.

Reclamation, Crankcase oil, Lubricating oil, Recycling

"A review with 4 references."

[from Chemical Abstracts 85(18):#126792h. 1976]

C-0216-77
A TECHNICAL AND ECONOMIC STUDY OF WASTE OIL RECOVERY. PART 4: ENERGY CONSUMPTION IN WASTE OIL RECOVERY. PART 5: A FIELD TEST OF THE QUALITY OF RE-REFINED LUBE OILS. PART 6: A REVIEW OF RE-REFINING ECONOMICS
Cukor, P. M., and T. Hall. 1975.
Final report, EPA-530/SW-90c.4Pt-4; EPA-530/SW-90c.4-Pt-5; EPA-530/SW-90c.4-Pt-6; Contract EPA-68-01-2904. PB-251716/7. 141p.

Recycling, Waste oil, Recovery, Fuel oil, Refining, Economics

An energy balance on waste oil recycling of lube oil and waste oil recovery of fuel oil, a field test on re-refined lube oil, and the economics of re-refining are reported.

[from Scientific and Technical Aerospace Reports 14(21):#N76-30681. 1976]

C-0217-77
RECYCLING OF USED AUTOMOTIVE AND INDUSTRIAL MINERAL OILS (product information)
Dalton & Co. Ltd. n.d.
Silkolene Oil Refinery, Belper, Derby DE5 1WF, England, UK

Crankcase oil, Lubricating oil, Waste oil, Refining, Reclamation, United Kingdom

The brochure lists authorized collectors and refiners of waste oils in the United Kingdom. Basic information on types of waste oil and methods for recovery is included.

[from Industrial Wastes Information Bulletin 7(3):#HMS 6854. 1976]

C-0218-77
WHY RE-REFINING OF SPENT LUBRICATING OILS
Goossens, A. G., and H. F. Westerduin. 1975.
Chemical Age India 26(12):995-1000.

Waste oil, Lubricating oil, Reclamation, Refining

A process for re-refining used lubricating oils is described which consists of pre-treatment vacuum distillation and hydrofinishing to stabilize and improve the color and odor. The process is pollution free.

[from Chemical Abstracts 85(10):#65416q. 1976]

C-0219-77
AN APPRAISAL OF EXPERIENCES ON I.I.P. PROCESS ON RE-REFINING OF I.C. ENGINE CRANKCASE OIL.
Joshi, T. C., and P. N. Bhanot. 1976.
Chemical Age India 26(12):1121-1128.

Crankcase oil, Reclamation, Refining, India

The article is a review of the Indian Institute of Petroleum's (I.I.P.) process for re-refining used engine crankcase oils.

[from Chemical Abstracts 85(10):65366y. 1976]

C-0220-77
REGENERATION OF WASTE OIL [in Japanese]
Kawase, Y. 1976.
Sekiyu To Sekiyu Kagaku 20(2):82-87.

Waste oil treatment, Reclamation, Refining, Japan

"A review of regeneration of waste oil in Japan."

[from Chemical Abstracts 85(10):#67556d. 1976]

C-0221-77
REGENERATION OF WASTE OIL. 3 [in Japanese]
Kawase, Y. 1976.
Sekiyu To Sekiyu Kagaku 20(3):87-93.

Waste oil treatment, Reclamation, Refining, Lubricating oil, Solvents, Japan

"A review with 6 references including refining with solvents in lubricating oil regeneration."

[from Chemical Abstracts 85(18):#129880w. 1976]

C-0222-77
OIL CHANGE. A REPORT ON RECYCLING USED SUMP OIL IN BRITAIN
Mackewn, J. 1976.
London, Friends of the Earth, 1976. 28p.

Waste oil, Environmental effects, Freshwater, Seawater, Reclamation, Recycling, United Kingdom

Information is presented on the quantity of used sump oil in the United Kingdom, its biological effects, and its hazards to marine and fresh waters. Current practices regarding reclamation and proposals for action by local pressure groups are given.

[from Industrial Wastes Information Bulletin 7(2):#HMS 6630. 1976]

C-0223-77
STATUS OF RECYCLING OF USED LUBRICATING AND TRANSFORMER OILS ON INDIAN RAILWAYS
Pandya, D.P. 1975.
Chemical Age India 26(12):1086-1090.

Refining, Recycling, Crankcase oil, Waste oil, India

"The refining of drained crankcase oil, axle oil, transformer oil and machinery oil in Indian Railway workshops is described."

[from Chemical Abstracts 85(10):#65421n. 1976]

C-0224-77
RECLAIMING USED MOTOR OIL
Phillips Petroleum Co. 1976.
U.S. Patent 3,930,988

Reclamation, Reuse, Waste oil, Lubricating oil, Fuels

"Metal contaminants are precipitated with aqueous ammonium sulphate and/or bisulphate and allowed to separate. The oil layer may be used as fuel or further treated with an adsorbant and optionally hydrotreated to produce a low metal/ash lubricant."

[from Industrial WastesInformation Bulletin 7(4):#HMS 7504. 1976]

3,930,988
RECLAIMING USED MOTOR OIL
Marvin M. Johnson, Bartlesville, Okla., assignor to Phillips Petroleum Company, Bartlesville, Okla.
Filed Feb. 24, 1975, Ser. No. 552,287
Int. Cl.² C10M *11/00*; C10G *17/00*
U.S. Cl. 208—182 **12 Claims**

C-0225-77
INDIAN RAILWAY'S APPROACH TO RECYCLING OF USED CRANKCASE LUBRICATING OIL
Prasada, A., and S. A. Singh. 1975.
Chemical Age India 26(12):1091-1096.

Recycling, Reuse, Crankcase oil, Lubricating oil, India

The Indian Railways developed an acid-and-clay treatment for re-refining used crankcase lubricating oils; this article describes the satisfactory recycling and reuse of such oils as railway lubricants.

[from Chemical Abstracts 85(10):#65422p. 1976]

C-0226-77
RESOURCE RECOVERY AND RECYCLING HANDBOOK OF INDUSTRIAL WASTES 1975
Sittig, M. 1975.
Park Ridge, New Jersey, Noyes Data Corporation, 1975. 427p.

Recycling, Solid wastes, Wastewaters, Waste oil, Hydrocarbons, Petrochemicals, Manuals

This environmental technology handbook emphasizes process technology and covers waste products such as metals, glass, oils and other organic materials. Available from Noyes Data Corporation, Mill St. at Grand Ave., Park Ridge, NJ 07656.

6. PERSONNEL TRAINING AND EDUCATION

C-0227-77
UK OIL POLLUTION CLEANUP FILM (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(10):180.

Oil spills, Cleanup, Personnel training, United Kingdom,
*Pollution cleanup film

A half hour film called "A Clean and Pleasant Land" has been produced by the United Kingdom Central Office of Information. The film describes the way in which the UK copes with oil pollution and illustrates the role of Warren Spring Laboratory in providing training, advice, and research for dealing with oil pollution. FFI contact Central Film Library, Government Building, Bromyard Avenue, London W3 7JB.

7. CONTINGENCY PLANNING

C-0228-77
ZERO OIL SPILLAGE IS AIM IN ALASKA PROGRAM (news brief)
Anon. 1976.
Offshore 36(12):242.

Contingency planning, Oil spills, Pipelines, Alaska, Cleanup, Restoration

Contingency plans required by stipulations in government permits for the pipeline have been submitted to state and federal governments by Alyeska Pipeline Service Company. These plans detail specific actions to be taken if an oil spill occurs along the 1300 km (800 mi) long Trans-Alaska pipeline system. Plans provide for detection of oil spillage, containment, cleanup, and restoration.

C-0229-77
AN OVERSEAS ROLE FOR THE STRIKE FORCE AGAINST OIL SPILLS
Fondiller, H. V. 1975.
Surveyor 9(4):23-26.

Contingency planning, Cleanup, Oil spills, Pollution prevention, Tankers, Government agencies, *USCG

A U.S. Coast Guard program is described for combatting major oil spills in U.S. and foreign waters. The program consists of three "National Strike Force" teams, each consisting of 15 highly trained personnel and specialized pollution control systems which are prepared to respond to major oil spills within two hours. The program has been proven effective in the "Metula" and "Showa Maru" tanker spills, as well as numerous spills in U.S. waters.

[from Oceanic Abstracts 13(5):#76-04628. 1976]

C-0230-77
EPA'S VIEW OF PROJECTED OIL DRILLING ON THE CONTINENTAL SHELF
Green, F. 1976.
Sea Technology 17(10):10-13,32.

Contingency planning, Oil spills, Offshore drilling, OCS, Oil transport, Atlantic coast, *Research needs, *EPA

A contingency plan is outlined for the protection of the Atlantic coastal environment, and needed research on continuous, low volume discharges of oil is described. Oil spills due to oil transport and offshore drilling are discussed and the Environmental Protection Agency's (EPA) views on the matter are outlined.

C-0231-77
GOVERNMENTS DEVELOP A BACKUP OIL SPILL CONTINGENCY PLAN FOR THE BEAUFORT SEA
Mansfield, B. H. 1976.
Spill Technology Newsletter 1(3):13-14.

Contingency planning, Oil spills, Beaufort Sea, Canada, Government agencies, Oil industry

A coordinated contingency plan has been developed by several Canadian government departments and agencies to deal with the possibility of an oil spill emergency in the Beaufort Sea. The plan is designed to be a back up program for oil industry cooperatives and operators.

B. PREVENTION AND CONTROL MEASURES

C-0232-77
CIVIL PENALTIES FOR VIOLATION OF OIL POLLUTION PREVENTION REGULATIONS: INTERIM REGULATIONS
Anon. 1974.
Federal Register 39(169):31601-31603.

Pollution prevention, Regulations, Law enforcement, *Civil penalties, *EPA

The regulations establish the procedures for the EPA to impose civil penalties for violations of EPA's Oil Pollution Prevention Regulations and include provisions for issuance of violation notices, requests for a hearing on the violation, the appointment of a presiding hearing officer, conduct of the hearing, and penalty appeal procedures. The costs assessed for civil penalties are discussed.

[from MRIS Abstracts. Vol. 13:#14 129744. 1976]

C-0233-77
DROP-IN VALVE COMPLETES BLOWOUT PROTECTION (product information)
Anon. 1976.
Journal of Canadian Petroleum Technology 15(3):105.

Blowout prevention, Drilling, Design and engineering, *Drop-in valve

The Hydril Drop-in Check Valve is a pump-down type of inside blowout preventer which completely closes the drill pipe when a blowout is imminent. The device is maintained topside until needed, then pumped down the drill pipe where it lodges to provide automatic check valve capabilities. FFI contact the Hydril Company, 714 West Olympic Blvd., Los Angeles, CA 90015.

C-0234-77
A SAFER FLOATING OIL HOSE (product information)
Anon. 1975.
Dock and Harbour Authority 56(659):177.

Pollution prevention, Crude oil, Oil transfer, Design and engineering, *SAFLOTE oil hose

The Dunlap Oil and Marine Division has developed the SAFLOTE floating hose with double carcass for transferring crude oil. In the event of a rupture of the primary carcass, the outer, secondary carcass contains and fills with the escaping oil; thereby distorting and increasing its outside diameter by at least 35% and visibly indicating the problem and preventing a spillage.

[from Oceanic Abstracts 13(6):#76-04787. 1976]

C-0235-77
FIGHTING OIL POLLUTION - SWEDISH STYLE
Author unknown. 1976.
Kelvin Hughes Review 55:16-17.

Oil spills, Pollution prevention, Sweden

Summary not available.

[from Underwater Information Bulletin 8(4):27. 1976]

C-0236-77
PREVENTION OF NUISANCE AND POLLUTION DURING THE EXPLORATION AND EXPLOITATION OF HYDROCARBONS IN THE SEA [in French]
Barbier, Y. 1975.
The Mediterranean and the Fight Against Marine Pollution Caused by the Production, Transport and Transformation of Energy and Primary Energetic Matter. Monaco, International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), 1975. p.23-27. Proceedings of the work of the Committee for the Fight Against Marine Pollution during the 24th Plenary Congress-Assembly, Monaco, December, 1974.

Pollution prevention, Offshore exploration, Hydrocarbons, Mediterranean Sea

"The potential origins of nuisances and pollutions inherent in the various steps of the exploration and exploitation of hydrocarbons offshore are detailed. A brief description of the means both important and very elaborated which are used in opposition to the possible effects of these origins is made."

[from Aquatic Sciences and Fisheries Abstracts 6(3):#6Q3324. 1976]

C-0237-77
OIL POLLUTION PREVENTION
Baum, R. L. 1975.
Federal Register 40(132):28849.

Pollution prevention, Oil spills, Storage, Oil discharges, Legislation, Contingency planning, *FWPCA

Requirements of Section 311 of the Federal Water Pollution Control Act (FWPCA) are briefly explained. Owners or operators of any onshore or offshore oil-related facility are to promptly report oil discharges and to have a certified Spill Prevention Control and Countermeasure (SPCC) Plan. The requirements of Section 101(a) of the FWPCA have been expanded to include not only petroleum, but also non-petroleum oil and fat processing and storage facilities.

[from Selected Water Resources Abstracts 9(20):#W76-10772. 1976]

C-0238-77
BUND/LAENDER - VEREINBARUNG ZUR BEKAEMPFUNG VON OELUNFAELLEN AN DER KUESTE UND AUF DER HOHEN SEE (FEDERAL/STATE AGREEMENT FOR COMBATTING OIL INCIDENTS ALONG THE COAST AND ON THE HIGH SEAS) [English summary]
Goe, C. 1975.
Deutsche Gewaesserkundliche Mitteilungen 19(Sonderheft): 127-128.

Government agencies, Germany, Pollution prevention, Oil spills, Coasts, Oceans

The Sea and Coast Oil Incident Committee was established to develop practicable technical and organizational procedures to be followed in the event of an oil incident. Based on its recommendations, the federal government and states reached an agreement on measures to be taken, including preliminary and final steps and financial settlements. The emergency action staff of the Cuxhaven Water and Shipping Control Agency is authorized to order all measures required to control emergency incidents.

[from Pollution Abstracts 7(5):#76-04389. 1976]

C-0239-77
OIL SPILL CLEAN-UP - APPLICATION OF EQUIPMENT AND METHODS
Brackley, P. G., and P. D. Holmes. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Petroleum Institute Environmental Conservation Executive, 1976. 24p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Pollution control, Oil spills, Cleanup, Contingency planning, Personnel training

Effective preparation and action in oil spill cleanup are discussed. The need for thorough contingency planning and personnel training is stressed because a wide variety of spill possibilities must be anticipated and a proper, rapid response must be assured in any onshore, inshore or offshore spill scenario. Preparedness should include reliable and suitable equipment, materials such as dispersants, and adequate technical support. Possible responses in a wide variety of possible spill situations are outlined and reviewed.

C-0240-77
APPLICATION OF ON-LINE INSTRUMENTATION FOR THE CONTROL OF WATER QUALITY IN THE PETROLEUM INDUSTRY
Condron, J. A., and T. J. Pusniak. 1975.
Analytical Instruments (13):83-86.

Pollution control, Water quality, Oil industry, *On-line Instrumentation

The accuracy, efficiency, and problems of on-line water quality control instrumentation in the petroleum industry are reviewed and compared based on a five year study of different methods.

[from Chemical Abstracts 85(14):#98804t. 1976]

C-0241-77
ACCIDENTAL OIL POLLUTION OF THE SEA
Department of the Environment, Central Unit on Environmental Pollution. 1976.
London, Her Majesty's Stationery Office, 1976. Pollution Paper No. 8 .

Oil spills, Oceans, Pollution prevention, Cleanup, Regulations, United Kingdom

Future oil spill risks at sea and the adequacy of the United Kingdom's measures to deal with the spills are discussed. Cleanup, recovery, and regulatory measures are reviewed and government regulations are outlined.

[from Marine Pollution Bulletin 7(10):197-198. 1976]

C-0242-77
SELECTION AND SENSITIVITY REQUIREMENTS FOR BLOWOUT CONTROL DETECTION INSTRUMENTS
Dittmer, A. K., and F. J. Fisher. 1976.
Society of Petroleum Engineers of the American Institute of Mechanical Engineers Fall Meeting, 51st, New Orleans, 1976. 8p. Preprint.

Blowout prevention, Detection, Pollution prevention, Drilling, Oil wells,

Blowout control and prevention planning requires a detection instrument that is specific and sensitive. Requirements will depend on the drilling environment; a computer will quantify the characteristics of hydrocarbon gas in the annulus of the drilling well.

[from Petroleum Abstracts 16(45):#226,511. 1976]

C-0243-77
AUSTRALIAN NATIONAL PLAN TO COMBAT OIL SPILLS
Gurr, G. J. 1975.
Australian Marine Science Bulletin 52:3-5.

Pollution prevention, Pollution control, Oil spills, Cleanup, Contingency planning, Australia

Summary not available.

[from Australian Science Index 20(2):#686. 1976]

C-0244-77
COUNTERMEASURE TO CONTROL OIL SPILLS IN WESTERN CANADA
Hall, P. L., and H. Quam. 1976.
Ground Water 14(3):163-169.

Pollution prevention, Oil spills, Government agencies, Industries, Canada, Legislation, Personnel training

Governments and industries in western Canada are working together to develop new legislation concerning the handling of refined petroleum products. Oil spill manuals, training manuals, and educational films have been developed to help prevent oil spills.

[from Selected Water Resources Abstracts 9(17):#W76-09346. 1976]

C-0245-77
THE CURRENT STATE OF OIL SPILL PREVENTION AND CONTROL IN THE UNITED STATES AND CANADA
Horn, S. A. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 31p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Oil spills, Pollution prevention, Pollution control, Legislation, U.S., Canada, Contingency planning, Oil discharges, Cleanup, Personnel training

Current oil spill prevention laws, contingency plans and practices in the U.S. and Canada are compared. In both countries, discharge of oil into waterways is an illegal act, and penalties are assessed for deliberate or accidental spillages and for lack of prompt notification. Provisions governing cleanup procedures and use of chemical dispersants are outlined. Industry and government spill preparedness programs consist of training schools, equipment testing and development programs, oil spill cooperatives, governmental emergency task forces, and private spill response contractors.

C-0246-77
EEB ACTIVITIES IN ARCTIC OIL SPILL COUNTERMEASURES
Logan, W. J. 1976.
Spill Technology Newsletter 1(4):15-17.

Oil spills, Arctic, Cleanup, Pollution control, Beaufort Sea

The Environmental Emergency Branch (EEB) of the Environmental Protection Service has investigated various oil spill countermeasures which might be useful in the arctic, ice-laden waters of the Beaufort Sea. Existing countermeasures such as in situ ignition are not found to be useful except under very limited conditions. The EEB is currently sponsoring a number of projects to upgrade existing techniques and to develop new oil spill countermeasures.

C-0247-77
LOUISIANA SUPERPORT STUDIES, REPORT 4. TECHNICAL APPENDICES TO RECOMMENDATIONS FOR THE ENVIRONMENTAL PROTECTION PLAN
Louisiana State University. 1974.
Technical report, NOAA-76020305; NTIS-COM-75-10314/AS. 227p.

Oil spills, Coasts, Louisiana, Environmental protection, Ports

The possible effects of oil spillage on Louisiana's coastal zone are discussed and technical methods for the reduction of oil spill possibilities are suggested. The Environmental Protection Plan recommendations are reviewed.

[from Sea Grant Publications Index 1975 1:#LSU-T-74-006. 1976]

C-0248-77
THE FIGHT AGAINST POLLUTION OF THE SEA BY HYDROCARBONS [in French]
Mourlon, J.-C. 1975.
The Mediterranean and the Fight Against Marine Pollution Caused by the Production, Transport, and Transformation of Energy and Primary Energetic Matter. Monaco, International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), 1975. p.63-67. Proceedings of the work of the Committee for the Fight against Marine Pollution during the 24th Plenary Congress-Assembly, Monaco, December, 1974.

Pollution prevention, Hydrocarbons, International conventions

Sources and controls of marine oil pollution are discussed with special reference to the London Convention of 1973.

[from Aquatic Sciences and Fisheries Abstracts 6(3):#6Q3325. 1976]

C-0249-77
CANMAR'S ENVIRONMENTAL PREDICTION AND OIL SPILL CLEANUP SYSTEM FOR THE SOUTHERN BEAUFORT SEA
O'Rourke, C. 1976.
Spill Technology Newsletter 1(4):7-10.

Blowout prevention, Drilling, Oil spills, Cleanup, Beaufort Sea, Booms, Skimmers, Contingency planning

The Environment Prediction System, which is a sophisticated weather forecasting system, will help prevent blowouts from drill ships and aid in assuring safe drilling operations by providing information on wind, wave, weather, ice and iceberg conditions for the Southern Beaufort Sea. The spill cleanup systems developed for Canadian Marine Drilling, Ltd., consist of a large, inflatable containment boom specially designed for Arctic conditions, and a Lockheed Clean-Sweep skimmer. In the event of oil escaping the boom or skimmer, contingency plans and techniques for burning this oil have been developed.

C-0250-77
LIABILITY, COMPENSATION, AND PREVENTION OF OIL SPILLS: A NORTH AMERICAN PERSPECTIVE
Pedrick, J. L. 1975.
Earth Law Journal 1(4):301-372.

Regulations, Legislation, Oil spills, Liability, Tankers, Safety, Pollution prevention

A chronological outline of international and national regulating responses to oil pollution is presented. Although progress is reported in the area of spill liability and liability assessment, the need for better liability protection, improved tanker safety, and spill prevention measures are called for. Two hundred references are included.

[from Environment Abstracts 6(7/8):#76-05040. 1976]

C-0251-77
OPERATION PREPAREDNESS - QUEBEC REGION
Pistruzak, W. M. 1976.
Spill Technology Newsletter 1(4):33-37.

Oil spills, St. Lawrence River, Pollution control, Contingency planning, Personnel training, Cleanup, *Field tests

A series of exercises were conducted in the St. Lawrence River in August, 1976, in order to test existing oil spill cleanup and control equipment, and to familiarize oil spill response teams and organizations with spill countermeasures and their field application. The tests involved the Canadian Coast Guard, the Environmental Emergency Section of Environment Canada, and teams from six private companies and organizations.

C-0252-77
PROTECTION OF THE MARINE ENVIRONMENT AGAINST POLLUTION IN THE MEDITERRANEAN
Sand, P. H. 1976.
Environmental Policy Law 1(4):154-159.

International conventions, Pollution control, Environmental protection, Oil discharges, Mediterranean Sea

Recent studies by the FAO Legal Office are reviewed; the studies include a 1974 survey of existing and proposed international conventions for the control of marine pollution and their relevance to the Mediterranean. Present or already completed programs, such as those by GESAMP, IMCO, and GFCM, are discussed. Pollution of the Mediterranean Sea by oil, sewage and industrial contaminants is documented.

[from Aquatic Sciences and Fisheries Abstracts 6(7):#6Q7619. 1976]

C-0253-77
ENVIRONMENTAL ASSESSMENT IN CREATING A REFINERY IN THE CARIBBEAN SEA. 2
Sugai, K. 1976.
Sekiyu To Sekiyu Kagaku 20(2):76-80.

Pollution control, Refineries, Environmental protection, Caribbean Sea

"Pollution control measures are described in the construction of a petroleum refinery with 200,000 barrels/day capacity."

[from Chemical Abstracts 85(10):#67465d. 1976]

C-0254-77
GROUNDING OF THE NEPCO 140, ST. LAWRENCE RIVER, JUNE 23, 1976
Vanderkooy, N. 1976.
Spill Technology Newsletter 1(4):24-32.

Oil spills, St. Lawrence River, Government agencies, U.S., Canada, Cleanup, Restoration, Birds

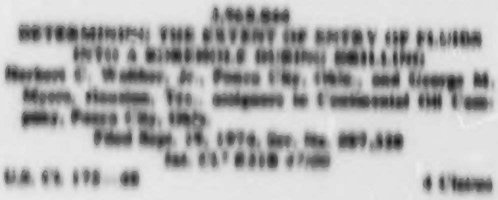
Countermeasures undertaken by U.S. and Canadian government agencies in controlling a recent oil spill into the St. Lawrence River are reviewed. The strategies and methods used in the containment, cleanup, recovery and restoration activities are detailed, and the attempts to save oiled birds are described. The NEPCO spill incident cost a total of $8 million in cleanup costs.

C-0255-77
DETERMINING THE EXTENT OF ENTRY OF FLUIDS INTO A BOREHOLE DURING DRILLING
Walther, H. C., Jr., and G. M. Meyers. 1976.
U.S. Patent 3,968,844

Pollution prevention, Blowout prevention, Drilling, Oil wells

Potential blowout conditions during well drilling can be detected by a method which involves (1) providing a bypass in the sidewall above the bypass valve of the drillstring, (2) momentarily stopping circulation of drilling fluid past the drill bit, and (3) observing the surface pressure of the drilling fluid system downstream from the mud pump.

[from Petroleum Abstracts 16(43):#226,086. 1976]



C-0256-77
SPILL PREVENTION AND CONTROL: A SPECIAL REPORT
Weiss, W. H. 1976.
Pollution Engineering 8(11):22-29.

Oil spills, Pollution prevention, Contingency planning, Booms, Skimmers, Monitoring

Methods and criteria for setting up a Spill Prevention Control and Countermeasure (SPCC) plan for a plant or industry to stop or contain an oil spill are reviewed. Pollution control equipment such as booms, skimmers, sorbents, and monitors are discussed.

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

C-0257-77
LABORATORY STUDIES ON THE EFFECTS OF OIL ON MARINE ORGANISMS
Anderson, J. W. 1975.
API Publication #4249. 70p.

Biological effects, Hydrocarbons, Marine organisms

Summary not available.

[from J. W. Anderson, Batelle Pacific Northwest Division,
Sequim, WA 98382]

C-0258-77
UPTAKE AND DEPURATION OF SPECIFIC HYDROCARBONS FROM OIL BY THE BIVALVES *RANGIA CUNEATA* AND *CRASSOSTREA VIRGINICA*
Anderson, J. W. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.690-708.

Hydrocarbons, Mollusks, Marine organisms, *Uptake and depuration

Groups of clams, *Rangia*, and oysters, *Crassostrea*, were subjected to oil-water emulsions of four test oils for long periods of time in order to test the hydrocarbon retention time in mollusks. Analysis of the mollusks for specific hydrocarbons indicated rapid depuration rates.

[from Selected Water Resources Abstracts 9(20):#W76-11024. 1976]

C-0259-77
ACCUMULATION AND RELEASE OF PETROLEUM HYDROCARBONS BY EDIBLE MARINE ANIMALS
Anderson, J. W., and J. M. Neff. 1976.
Recent Advances in the Assessment of the Health Effects of Environmental Pollution. Luxembourg, Commission European Communities, 1976. Vol. 3. p.1461-1469.

Fate, Hydrocarbons, Marine organisms, Fuel oil, Fishes, Mollusks, Crustaceans, *Accumulation and release studies

Oysters experimentally exposed to up to 400 ppm dispersed fuel oil for eight hours rapidly accumulated a broad spectrum of different hydrocarbons. Methylnaphthalenes were accumulated to higher concentrations than other hydrocarbons. When returned to oil-free seawater, naphthalenes were released to background levels in 28 days. In similar experiments with clams, shrimp, and fish, release of naphthalenes to low or undetectable levels was achieved in 6-14 days.

[from J. W. Anderson, Battelle Pacific Northwest Division,
Sequim, WA 98382]

C-0260-77
POLLUTION EFFECTS ON SEABIRDS (news brief)
Anon. 1976.
Marine Pollution Bulletin 7(10):180.

Biological effects, Birds, Offshore development, Fisheries, Scotland, *Conference

"An international conference is to be held in Aberdeen, Scotland from 26-28 March 1977 on the *Changing Seabird Populations of the North Atlantic*. On March 27th the conference will look in depth at the topic of human influences - fisheries, oil developments and chemical pollution. For further details of the programme write to: Chris Mead, British Trust for Ornithology Beech Grove, Tring, Herts HP23 5NR."

C-0261-77
EFFECTS OF CRUDE OIL AND DISPERSANTS ON BIVALVES
Avozali, R. J., and Nuwayhid. 1974.
Marine Pollution Bulletin 5(10):149-152.

Biological effects, Dispersants, Crude oil, Toxicity, Mollusks, *Respiration rate

"The toxic effects of crude oil, the dispersant Corexit 7664, and mixtures of two species of bivalve have been examined. A light Arabian crude is most toxic to one, Corexit is most toxic to the other. The susceptibility to oil of the mussel, *Brachidontes* is also reflected in a significant depression of respiration rate at sub-lethal concentrations."

[from Baseline Study Program North Puget Sound. Biological Oil Impact Literature Review. Volume II. Bibliography. No. PB-254 292]

C-0262-77
PATTERNS OF OIL SEDIMENT REJECTION IN CORALS
Bak, R. P. M., and J. H. B. W. Elgershuizen. 1976.
Marine Biology 37(2):105-113.

Biological effects, Contamination, Sediments, *Corals

The effect of oil polluted sediment on various colonial corals was experimentally determined, using clean sediment as controls. The corals were found to rid themselves of clinging, oily sediment particles by patterns of mucus secretion and ciliary action which are identical to the patterns of rejection for clean sediments. Oil drops of ≥ 0.06 mm diameter do not adhere to living coral tissue and are not ingested. The toxicity of oil in seawater is believed to be more harmful to corals than physical contact with oil sediment particles.

C-0263-77
EFFECTS OF OIL ON THE MARINE ENVIRONMENT
Baker, J. M. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 17p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Acute effects, Chronic effects, Oil spills, Petroleum products, Refineries, Marine organisms, Monitoring

Approaches used by the Oil Pollution Research Unit in studying the acute and chronic effects of oil and related pollutants to the marine environment are outlined. These are primarily field surveys, biological monitoring, and field experiments supplemented by laboratory studies. The research has shown that the effects of oil spills, cleanup agents, and refinery effluents cannot be generalized because of a great number of variables that determine the extent of damage. The monitoring of oil-related industries is emphasized, and some objectives, methods, and problems of biological monitoring schemes are discussed.

C-0264-77
STUDIES ON THE EFFECTS OF TWO OIL COLLECTING AGENTS ON AQUATIC ORGANISMS OF LAKE MARACAIBO
Bean, R. M., and E. A. Sutton. 1974.
Technical report, Battelle-Northwest Laboratories.

Biological effects, *Oil collecting agents, Lakes, Venezuela, *Lake Maracaibo

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655, p.7]

C-0265-77
STUDY OF EFFECTS OF OIL DISCHARGES AND DOMESTIC AND INDUSTRIAL WASTEWATERS ON THE FISHERIES OF LAKE MARACAIBO, VENEZUELA. VOL.II. FATE AND EFFECTS OF OIL
Bean, R. M., and E. A. Sutton. 1974.
Technical report, Battelle-Northwest Laboratories. W. L. Templeton (ed.).

Oil discharges, Wastewaters, Biological effects, Fate, Fisheries, Lakes, Venezuela, Economics, *Lake Maracaibo

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655, p.7]

C-0266-77
INTERDISCIPLINARY STUDY OF THE TOXICITY OF PETROLEUM TO MARINE ORGANISMS
Dean, R. M., J. R. Vanderhorst, and P. Wilkinson. 1974.
Richland, Washington, Battelle Pacific Northwest Laboratories, Final report. 31p.

Crude oil, Hydrocarbons, Toxicity, Fishes, Crustaceans, Chemical analysis, *Oil solubles

The influence of oil solubles on juvenile salmon and coonstripe shrimp is examined and a system for chemically characterizing the soluble hydrocarbons is described. Interpretations and conclusions regarding toxic responses of the organisms are included.

[from Baseline Study Program North Puget Sound. Biological Oil Impact Literature Review. Volume II. Bibliography. No. PB-264 292]

C-0267-77
THE ROLE OF WATER-SEDIMENT INTERACTION IN THE OSTEND SLUICE DOCK WITH REGARD TO THE TOXICITY OF POLLUTANTS TO INVERTEBRATE LARVAE
Benijts, F., and D. Versichele. 1975.
Sublethal Effects of Toxic Chemicals on Aquatic Animals. J. H. Koeman, and J. J. T. W. A. Strik (eds.). New York, Elsevier Scientific Publishing Co., 1975. p.221-234. Proceedings of the Swedish-Netherlands Symposium, Wageningen, The Netherlands, September, 1975.

Toxicity, Contaminants, Hydrocarbons, Invertebrates, Mollusks, Seawater, Sediments, North Sea, *Oysters

An investigation was conducted to identify and determine the source of organic substances which were interfering with larval development of oyster cultures in the sluice dock at Ostend. Chromatographic analyses showed that stagnant sluice dock waters were highly toxic due to the high concentration of petroleum-based aliphatic hydrocarbons. It is concluded that the contaminants are leached out of oil-polluted sediments which are deposited in the quiet waters of the sluice dock area.

C-0268-77
OIL SPILLS
Blumer, M., H. L. Sanders, J. F. Grassle, and G. R. Hampson.
1975.
The Social Costs of Power Production. B. Commoner (ed.), New
York, Macmillan Publishing Company, 1975. Vol. 1. p.81-95.

Oil spills, Biological effects, Toxicity, Marine organisms,
Massachusetts, *West Falmouth Spill

This chapter discusses the immediate and long range environmental and biological damage inflicted by oil spills, using the 1970 West Falmouth, Massachusetts oil spill as a case history. The persistent, destructive effects of this spill, which were documented over a period of years, on marine biotic communities are emphasized.

C-0269-77
ANALYSIS OF POLLUTION FROM MARINE ENGINES AND EFFECTS ON ENVIRONMENT
Boating Industry Association, Chicago. n.d.
U.S. Environmental Protection Agency. 71p.

Biological effects, Hydrocarbons, Phytoplankton, Zooplankton,
Benthos, Water quality, Gasoline, *Marine engine emissions

Four ponds were exposed to outboard engine emissions at a rate three times greater than that from saturation boating levels. Small changes in phytoplankton species variation and productivity, zooplankton population dynamics, the benthic microinvertebrate community, and general water quality could not be ascribed to emissions effects to the exclusion of natural stress.

C-0270-77
OIL POLLUTION OF THE RIVER YTHAN
Bourne, W. R. P. 1976.
Marine Pollution Bulletin 7(8):139.

Biological effects, Fuel oil, Oil spills, Birds, Scotland,
Pollution control, *River Ythan

The pollution of the River Ythan by diesel fuel and the measures taken by various pollution control agencies of Scotland are discussed. Only a few Eiders and Terns have been killed, although damage to eggs in a nearby breeding ground has not been assessed.

C-0271-77
SECTION 5: THE POSSIBLE EFFECTS OF OIL SPILLS ON MARINE BIRDS
Brown, R. G. B. 1974.
Summary of Physical, Biological, Socioeconomic and Other Factors Relevant to Potential Oil Spills in the Passamaquoddy Region of the Bay of Fundy. Fisheries Research Board of Canada Technical Report 428. p.121-140.

Biological effects, Oil spills, Contamination, Birds, Canada, *Bay of Fundy, Chronic effects

The Passamaquoddy Bay area is an important wintering area or stop over for migrating birds including several species of diving ducks, Phalaropes, Greater shearwaters, and kittiwakes. Oil contamination of the eelgrass beds would be lethal to Brant geese. The cumulative adverse effects of small spills or chronic pollution represents a greater threat to the waterfowl of the area than does the danger of occasional oil spills.

[from Baseline Study Program. North Puget Sound. Biological Oil Impact Literature Review. Volume II. Bibliography. No. PB-254 292]

C-0272-77
BASELINE STUDY PROGRAM. NORTH PUGET SOUND. BIOLOGICAL OIL IMPACT LITERATURE REVIEW. VOLUME I. TEXT
Buell, J. W., and V. W. Kaczynski. 1976.
Final report, WA/DOE/BR-75/01. 204p.

Biological effects, Oil spills, Petrochemicals, Marine organisms, Puget Sound, *Literature review

Literature on the impact of oil upon the significant biological resources of Puget Sound is reviewed and analyzed. Possible effects of oil spills and petrochemical spills on the biota are considered. Interpretive data is summarized by organism and habitat. (See also Volume II, Bibliography; C-0438-77, p. 174.)

[from Government Reports Announcements 76(19):#PB-254 291/8GA. 1976]

C-0273-77
IMPACT OF CHRONIC AND ACUTE OIL POLLUTION ON SEA BIRDS
Clark, R. B. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.619-631.

Chronic effects, Acute effects, Oil spills, Birds, Pollution prevention, Conservation

Seabirds are the most vulnerable organisms to oil pollution because they spend most or almost all of their lives on the water, they dive to collect food, and they are weak fliers or flightless. This paper reviews information collected on the impact of oil pollution on seabirds and includes discussions on remedial measures to prevent oil spills, treatment of oil spills, treatment of oiled birds, and seabird conservation.

[from Selected Water Resources Abstracts 9(20):#W76-11020, 1976]

C-0274-77
HYDROCARBONS IN MARINE ZOOPLANKTON AND FISH, PART 1
Corner, E. D. S., and R. P. Harris. 1976.
Effects of Pollutants on Aquatic Organisms. A. P. M. Lockwood (ed.). New York, Cambridge University Press, 1976. p.71-85.

Biological effects, Hydrocarbons, Zooplankton, Toxicity, Metabolism

The long and short-term effects of petroleum hydrocarbons on zooplankton are reviewed, with emphasis on toxicity, tainting, behavioral responses, uptake, and metabolism. Experiments still in progress are discussed.

C-0275-77
EFFECTS OF WATER SOLUBLE FRACTIONS OF KUWAIT CRUDE OIL AND NO. 2 FUEL OIL (AMERICAN PETROLEUM INSTITUTE STANDARDS) ON THE LARVAL DEVELOPMENT OF THE MUD CRAB, EURYPANOPEUS DEPRESSUS (SMITH)
Cucci, T. L., and C. E. Epifanio. 1976.
American Zoologist 16(2):250. Abstract.

Toxicity, Acute effects, Chronic effects, Crude oil, Fuel oil, Metabolism, Crustaceans, *Mud crab

The title study was conducted to determine the acute toxicities of two oils on each larval stage of the mud crab, and to assess chronic effects of the oils upon the molting frequency and growth rate of its larval and post-larval stages.

C-0276-77
SEA-URCHIN EGG DEVELOPMENT UNDER THE ACTION OF BENZO-A-PYRENE AND 7-12-DIMETHYL BENZ-A-ANTHRACENE
DeAngelis, E., and G. G. Giordano. 1974.
Cancer Research 34(6):1275-1280.

PAH, Biological effects, Marine organisms, Echinoderms, *Egg development

The effect of benzo(a)pyrene (BP) and 7,12-dimethyl-benz(a)-anthracene (DMBA) was measured on dividing and differentiating cells in eggs of the sea urchin, *Paracentrotus lividus*. The action of BP on fertilized eggs and gametes before fertilization differs from that of DMBA in that the latter substance showed a specific damaging action on mesenchyme cells, which appeared to have lost their capacity to organize the skeleton. The former substance did not interfere with the normal function of the cell.

C-0277-77
EFFECTS OF OIL ON MARINE ECOSYSTEMS: A REVIEW FOR ADMINISTRATORS AND POLICYMAKERS
Evans, D. P., and S. D. Rice. 1974.
U.S. National Marine Fisheries Service Bulletin 72(3):625-638.

Contamination, Oil spills, Chronic effects, Ecosystems, EIS, Pipelines, Alaska

"A review of selected literature [is] surveyed for the marine section of the Environmental Impact Statement for the proposed Trans-Alaska pipeline project, emphasizing the need for research on the effects of chronic low level pollution."

[from Baseline Study Program North Puget Sound. Biological Oil Impact Literature Review. Volume II. Bibliography. No. PB-254 292]

C-0278-77
DIRECT AND INDIRECT EFFECTS OF OIL ON RINGED SEALS (*PHOCA HISPIDA*) OF THE BEAUFORT SEA
Geraci, J. R., and T. G. Smith. 1976.
Journal of the Fisheries Research Board of Canada 33(9):1976-1984.

Contamination, Crude oil, Marine mammals, *Ringed seals, Biological effects, Offshore development

Results are given from a study to evaluate the behavioral, physiological, and pathological consequences of crude oil contact and ingestion on wild ringed seals. Effects of longer contact as would be the situation in an offshore oil well blowout are discussed; the possible effects of large-scale offshore oilfields are also considered.

C-0279-77

REDUCTION IN CARBON FLUX IN *MYA ARENARIA* CAUSED BY A SPILL OF NO. 6 FUEL OIL

Gilfillan, E. S., D. Mayo, S. Hanson, D. Donovan, and L. C. Jiang. 1976.
Marine Biology 37(2):115-123.

Biological effects, Oil spills, Fuel oil, Metabolism, Mollusks, **Mya arenaria*, *Carbon flux

Carbon flow rates were calculated from respiration, assimilation, and filtration data which was determined on a monthly basis for two populations of *Mya arenaria* in Casco Bay, Maine; one of which was heavily polluted by a spill of No. 6 fuel oil. Although the carbon flow trends were similar for each population, the oiled population gained 60% less carbon than the unoiled population. The difference results from the uptake of hydrocarbons by the oiled population.

C-0280-77

EVALUATION OF THE ENVIRONMENTAL IMPLICATIONS OF OIL SPILL DISPERSANTS

Gilmour, A. J., and D. S. Negilski. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 27p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Oil spills, Dispersants, Toxicity, Acute effects, Chronic effects, Marine organisms, *Environmental stress

The biological and physico-chemical characteristics of the marine environment are briefly reviewed in order to provide a background for examining the nature, severity and extensiveness of environmental stress and damage caused by oil and oil dispersants. The toxicity, persistence, and acute and chronic effects of components of crude oil and dispersants in the marine environment are discussed, and various approaches to evaluating environmental stress caused by these pollutants are outlined.

C-0281-77
MIXED-FUNCTION OXIDASE (MFO) ACTIVITY IN FLORIDA MARINE SPECIES
James, M. O., and J. R. Bend. 1976.
Pharmacologist 18:207.

Metabolism, Contaminants, Marine organisms, Toxicity

Many chemicals including petroleum hydrocarbons which contaminate the marine environment are metabolized in mammalian species via the MFO systems to products which are often more toxic. Cytochrome P-450 content and benzo(a)pyrene hydroxylase, 7-ethoxycoumarin O-deethylase, and benzphetamine N-demethylase activities were measured in several Florida marine species. Results are presented.

C-0282-77
JP-4 and JP-9 FUEL TOXICITY STUDIES USING FRESH WATER FISH AND AUFWUCHS
Klein, S., R. Cooper, and D. Jenkins. 1976.
Annual research report 1974-1975, AMRL-TR-76-50; Contract F33615-73-C-4059. 68p.

Toxicity, Fuels, Fishes, Freshwater, *Jet engine fuels

Materials evaluated include RJ-4, RJ-5, methylcyclohexane, JP-9, and JP-4. Techniques for organism exposure and results of such exposures are presented.

C-0283-77
ACUTE TOXICITY OF CRUDE OIL TO FISH FRY AND THE INTAKE OF SUB-LETHAL CONCENTRATIONS OF CRUDE OIL HYDROCARBONS BY THE FISH ORGANISM (English summary)
Kuehnhold, W. W. 1975.
Bonn Bundesministerium für Forschung und Technologie, Final report, BMFT-FB-M-75-07. 33p.

Biological effects, Crude oil, Toxicity, Emulsifiers, Fishes

The acute and chronic toxic effects of dissolved crude oil fractions on embryonic and larval development of cod and herring were determined using three different crude oils with and without a nontoxic emulsifying agent. Use of the emulsifier was found to increase the toxicity of a given crude oil with time. The laboratory procedures used and resulting problems are discussed.

[from Scientific and Technical Aerospace Reports 14(17):#N76-26724. 1976]

C-0284-77
FATE OF PETROLEUM HYDROCARBONS TAKEN UP FROM FOOD AND WATER BY THE BLUE CRAB *CALLINECTES SAPIDUS*
Lee, R. F., C. Ryan, and M. L. Neuhauser. 1976.
Marine Biology 37(4):363-370.

Fate, Hydrocarbons, Metabolism, Crustaceans, *Blue crab

Radiolabeled aromatic and paraffinic hydrocarbons were taken up from food and water by the blue crab *Callinectes sapidus*; about 10 percent of the hydrocarbons were assimilated. More than 50 percent of the radioactivity assimilated was in the hepatopancreas. Twenty-five days after exposure, radioactivity was found only in the hepatopancreas, suggesting that this organ was the site of hydrocarbon metabolism. No evidence was found of hydrocarbon storage by any of the crab tissues.

C-0285-77
EFFECTS OF POLLUTANTS ON AQUATIC ORGANISMS
Lockwood, A. P. M. (ed.). 1976.
New York, Cambridge University Press, 1976. 193p.

Biological effects, Hydrocarbons, Fishes, Algae, Invertebrates, *Physiological effects, *Biochemical effects

Experimental studies on the physiological and biochemical effects of a wide range of pollutants including hydrocarbons on fish, algae, and invertebrates are reported. Effects at the sublethal level are emphasized.

C-0286-77
TOWARDS A MODEL OF THE EFFECTS OF OIL ON MARINE ORGANISMS
Moore, S. F. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.619-631.

Models, Biological effects, Oil spills, Marine organisms

A model is described that provides a concise and systematic framework for challenging various hypotheses regarding the effects of oil on marine organisms.

[from Selected Water Resources Abstracts 9(20):#W76-11021. 1976]

C-0287-77
OIL POLLUTION AND SHELLFISH
Neff, J. M. 1974.
National Shellfish Sanitation Workshop, 8th. D. S. Walt (ed.).
National Shellfish Safety Program, 1974. p.72-76.

Biological effects, Hydrocarbons, Crustaceans, Mollusks,
*Shellfish, *Oil pollution

Summary not available.

[from J. W. Anderson, Battelle Pacific Northwest Division,
Sequim, WA 98382

C-0288-77
POSITION PAPER ON THE EFFECTS OF ACUTE OIL SPILLS
North, W. J. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.758-777.

Environmental effects, Oil spills, Acute effects

Oil spills cause relatively limited disturbances that do not overtax recovery potentials of the environment. However, since recovery periods are long, substantial effort should be made to prevent acute oil spills.

[from Selected Water Resources Abstracts 9(20):#W76-11028. 1976]

C-0289-77
BIOLOGICAL CONSEQUENCES OF AN ACCIDENTAL OIL POLLUTION FOR ROCKY SHORES OF NORMAN COAST. RESULTS ONE YEAR AFTER OIL POLLUTION ON NOVEMBER 26TH, 1974
Peltier, J. C., W. Dupont, and J. P. Dupont. 1976.
Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales 170(2):442-448.

Oil spills, Dispersants, Biological effects, Mollusks, Marine organisms, France, *Norman Coast

In areas where detergents were not used, mussels and other sessile animals of the rocky shores have metabolized and excreted the accumulated hydrocarbons. In areas where detergents were used to disperse the spill, significant biological and ecological damage has been documented.

C-0290-77
EFFECTS OF CRUDE OILS ON ARCTIC MARINE INVERTEBRATES
Percy, J. A., and T. C. Mullin. 1975.
Beaufort Sea Project, Department of the Environment, Canada.
Beaufort Sea Technical Report 11. 171p.

Biological effects, Crude oil, Marine organisms, Invertebrates, Arctic, Habitats, Toxicity, Metabolism

The biological effects of crude oil on arctic marine invertebrates were investigated in three distinct habitats: the sub-ice, the neritic, and the benthic habitats. Toxicity studies indicated a relatively high tolerance level for crude oil among most species, but activity and metabolism were impaired by exposure to low oil concentrations.

[from Aquatic Sciences and Fisheries Abstracts 6(10):#6Q11069. 1976]

C-0291-77
INVESTIGATIONS ON THE INFLUENCE OF CRUDE OIL ON SURVIVAL AND OXYGEN CONSUMPTION OF *IDOTEA BALTICA* AND *GAMMARUS SALINUS*
[English summary]
Ponat, A. 1976.
Kieler Meeresforschung 31(1):26-31.

Biological effects, Crude oil, Marine organisms, Crustaceans, *Oxygen consumption

Idotea baltica and *Gammarus salinus* were exposed to a 0.1 mm layer of crude oil for 4 hours. The mean survival time for *G. salinus* was 2 days compared to the control value of 31 days; *I. baltica* showed greater resistance with a mean survival time of 46 days and a control value of 56 days. Oxygen consumption was reduced by 60% and 30% in *G. salinus* and *I. baltica* respectively.

[from Biological Abstracts 62(8):#43407. 1976]

C-0292-77
COMMUNITY AND SPECIES RESPONSE OF CHIRONOMIDAE (DIPTERA) TO CONTAMINATION OF FRESH WATERS BY CRUDE OIL AND PETROLEUM PRODUCTS, WITH SPECIAL REFERENCE TO THE TRAIL RIVER, NORTHWEST TERRITORIES
Rosenberg, D. M., and A. P. Wiens. 1976.
Journal of The Fisheries Research Board of Canada 33(9):1955-1963.

Biological effects, Contamination, Crude oil, Petroleum products, Freshwater, Canada, *Chironomidae

Responses of larval Chironomidae to experimental contamination of artificial substrates were investigated, and results of recent field studies involving effects of oil and petroleum products on these organisms in fresh water. are reviewed. Eleven species of Chironomidae which showed either positive or negative responses to oil contamination were evaluated for their potential to indicate oil pollution of freshwater ecosystems. It was predicted that *Nilotanypus fimbriatus* (Walk.), *Cricotopus bicinctus* (Meig.), and *C. varipes* Coq., individually or as an assemblage, would fulfill this role.

C-0293-77

INTERACTIONS BETWEEN PETROLEUM HYDROCARBONS AND THE POLYCHAETOUS ANNELID, *NEANTHES ARENACEODENTATA*: EFFECTS ON GROWTH AND REPRODUCTION: FATE OF DIAROMATIC HYDROCARBONS ACCUMULATED FROM SOLUTION OR SEDIMENTS

Rossi, S. S. 1976.
Submitted to Texas A & M University, Graduate College.

Hydrocarbons, Polychates, Biological effects, Fate, **Neanthes arenaceodentata*

Summary not available.

[from J. W. Anderson, Battelle Pacific Northwest Division, Sequim, WA 98382]

C-0294-77

SOME BIOLOGICAL EFFECTS RELATED TO THE WEST FALMOUTH OIL SPILL

Sanders, H. L. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.778-800.

Oil spills, Fuel oil, Emulsifiers, Biological effects, Marine organisms, Intertidal zone, Massachusetts, *West Falmouth spill

Detailed observations were made of the subtidal and intertidal fauna after spill emulsifiers were added to remove the No. 2 fuel oil off West and North Falmouth, Massachusetts. A discussion is given of the results of this study.

[from Selected Water Resources Abstracts 9(20):#W76-11029. 1976]

C-0295-77
EFFECT OF CRUDE OIL ON POPULATIONS OF BACTERIA AND ALGAE IN ARTIFICIAL PONDS SUBJECT TO WINTER WEATHER AND ICE FORMATION
Shindler, D. B., B. F. Scott, and D. B. Carlisle. 1975.
Theoretische und Angewandte Limnologie 19:2138-2144.

Oil spills, Biological effects, Bacteria, Algae, Freshwater, Canada

The title study showed that after an oil spill enters pond waters, an initial selection favoring one or a few oil-degrading bacterial types takes place followed by the gradual development of greater microbial diversity. Ponds that were studied remained aerobic the following summer and supported strictly aerobic bacteria such as Azobacter.

[from Selected Water Resources Abstracts 9(16):#W76-08453. 1976]

C-0296-77
SOME CONSIDERATIONS OF THE CHRONIC EFFECTS OF PETROLEUM IN THE MARINE ENVIRONMENT
St. Amant, L. S. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.671-689.

Chronic effects, Production, Environmental effects, *Oil pollution

Past studies on the chronic effect of petroleum pollution and production activities on the marine environment have been inadequate due to difficulties in measuring the effects of low levels of oil on the marine system.

[from Selected Water Resources Abstracts 9(20):#W76-11023. 1976]

C-0297-77
STUDIES ON THE EFFECTS OF TWO OIL COLLECTING AGENTS ON AQUATIC COMMUNITIES OF LAKE MARACAIBO
Sutton, E. A., and R. C. Arnett. 1974.
Technical report, Battelle-Northwest Laboratories.

Biological effects, *Oil collecting agents, Lakes, Venezuela, *Lake Maracaibo

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655. p.118]

C-0298-77
STUDY OF EFFECTS OF OIL DISCHARGES AND DOMESTIC AND INDUSTRIAL WASTEWATERS ON THE FISHERIES OF LAKE MARACAIBO, VENEZUELA
VOL. I. ECOLOGICAL CHARACTERIZATION AND DOMESTIC AND INDUSTRIAL WASTES
Sutton, E. A., and R. M. Bean. 1974.
Technical report, Battelle-Northwest Laboratories. W. L. Templeton (ed.). 84p.

Oil discharges, Wastewaters, Biological effects, Fisheries, Lakes, Venezuela, Economics, *Lake Maracaibo

Summary not available.

[from A Bibliography of Environmental Research: Ecosystems Department 1952-1975. Battelle-Northwest, No. BNWL-SA-4655. p.118]

C-0299-77
THE TOXICITY AND PHYSIOLOGICAL EFFECTS OF OIL AND PETROLEUM HYDROCARBONS ON ESTUARINE GRASS SHRIMP *PALAEMONETES PUGIO HOLTHUIS*
Tatem, H. E. 1975.
Submitted to Texas A & M University, Graduate College.

Toxicity, Hydrocarbons, Crustaceans, *Estuarine grass shrimp, **Palaemonetes pugio*

Summary not available.

[from J. W. Anderson, Battelle Pacific Northwest Division, Sequim, WA 98382]

C-0300-77
ACCUMULATION, RELEASE, AND RETENTION OF PETROLEUM HYDROCARBONS BY THE OYSTER, *CRASSOSTREA VIRGINICA*
Teal, J. M., and J. J. Stegeman. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.571-602.

Metabolism, Hydrocarbons, Monitoring, Fate, Mollusks, *Oysters

The accumulation, assimilation, and discharge of petroleum hydrocarbons by two oyster populations differing in fat content were monitored under laboratory conditions. Equilibration and the occurrence of multiple compartments where hydrocarbons can reside are major factors involved in the uptake of nonbiogenic hydrocarbons; those hydrocarbons contained in the oysters differed from the contaminant oil by containing a greater amount of aromatics.

[from Selected Water Resources Abstracts 9(20):#W76-11018. 1976]

C-0301-77
THE PRESENCE OF POLLUTANT HYDROCARBONS IN ESTUARINE EPIPELIC DIATOM POPULATIONS
Thompson, S., and G. Eglinton. 1976.
Estuarine and Coastal Marine Science 4(4):417-425.

Fate, Crude oil, PAH, Hydrocarbons, Algae, Sediments, Estuaries, England, *Diatoms

Organic extracts of epipelic diatoms from Severn estuary sediments were found to contain aliphatic hydrocarbons but no polynuclear aromatic hydrocarbons (PAH). The environmental significance of the exclusion of PAH and incorporation of crude oil aliphatic hydrocarbons from diatom lipid is discussed.

[from Water Research Centre Information 3(33):#76-23465. 1976]

C-0302-77
EFFECT OF PETROLEUM HYDROCARBONS ON ALGAL PHYSIOLOGY: A REVIEW AND PROGRESS REPORT
Vandermeulen, J. H., and T. P. Ahern. 1976.
Effects of Pollutants on Aquatic Organisms, A. P. M. Lockwood (ed.). New York, Cambridge University Press, 1976. p. 107-125.

Biological effects, Crude oil, Hydrocarbons, Algae, *Naphthalene, *Algal physiology

The physiological effects on unicellular algae of whole crude oils, distillate fractions, and some individual compounds are reviewed. Experimental problems associated with hydrocarbons and errors resulting from these problems are considered. The effects of naphthalene on the stability of the algal photosynthetic machinery and on ATP production are discussed.

C-0303-77
OIL THREAT TO AQUATIC BIRDS ALONG THE YUKON COAST
Vermeer, K., and G. C. Anweiler. 1976.
Wilson Bulletin 87(4):467-480.

Biological effects, Oil spills, Birds, Canada, Coasts

Oil spills that may occur along the Yukon coast in Canada will be most hazardous to oldsquaws and surf-scoters because of their population densities, long molting periods, reaction to spills, and nearness to expected oil exploration activities. Migrating seaducks which stop at coastal lagoons and river deltas will also be vulnerable to oil pollution.

[from Abstracts on Health Effects of Environmental Pollutants 5(6):#7789. 1976]

C-0304-77
EFFECTS OF CRUDE OIL ON AMERICAN LOBSTER (HOMARUS AMERICANUS) LARVAE IN THE LABORATORY
Wells, P. G., and J. B. Sprague. 1976.
Journal of the Fisheries Research Board of Canada 33(7):1604-1614.

Biological effects, Crude oil, Crustaceans, Monitoring, Toxicity, *American lobster

The toxic effects of Venezuelan Tia Juana crude oil on American lobster (Homarus americanus) larvae were monitored at various stages of growth. The threshold for retardation of larval development was 0.14 mg/l oil, and the ratio of "safe" to acutely lethal concentrations was about 0.03. Post larval lobsters dug significantly more burrows when the substrate contained oil. The lobsters did not avoid oil substrate nor was growth or survival affected in substrates containing up to 1740 mg/l of oil.

C-0305-77
HYDROCARBONS IN MARINE ZOOPLANKTON AND FISH, PART 2
Whittle, K. J., and P. R. Mackie. 1976.
Effects of Pollutants on Aquatic Organisms. A. P. M. Lockwood (ed.). New York, Cambridge Univeristy Press, 1976. p.85-105.

Biological effects, Hydrocarbons, Fishes, Toxicity, Metabolism

The long and short-term effects of petroleum hydrocarbons on fishes are reviewed, with emphasis on toxicity, tainting, behavioral responses, uptake, and metabolism. Experiments still in progress are discussed.

C-0306-77
TEMPERATURE, SALINITY AND OIL EFFECTS ON THE INGESTION, EGESTION AND GROWTH OF NEANTHES ARENACEODENTATA
Young, L., and J. W. Anderson. 1976.
American Zoologist 16(2):238. Abstract.

Biological effects, Metabolism, Crude oil, Polychaetes, *Neanthes arenaceodentata

Variations in temperature or salinity were found to have a greater effect on the metabolism and growth of Neanthes arenaceodentata than did water soluble fractions of Southern Louisiana crude oil.

2. ECONOMIC EFFECTS

C-0307-77
REMOVAL OF EXTRA LIGHT FUEL OIL FROM POLLUTED WATER [in German]
Engels, C. 1975.
Vom Wasser 45:45-51.

Economics, Cleanup, Fuel oil

"During prosecution in a case of water pollution violations there exists the problem of determining the actual costs of pollution. An example of pollution by extremely light fuel oil, Extraleicht (HEL), is presented to illustrate the calculation of costs of cleaning a polluted water body by this common mineral oil."

[from Environmental Health and Pollution Control 10(4):#921. 1976]

3. GENERAL EFFECTS

C-0308-77
ADVISORY COMMITTEE ON OIL POLLUTION OF THE SEA. ANNUAL REPORT FOR 1975
Anon. 1976.
London, Advisory Committee on Oil Pollution of the Sea, 1976. 36p.

Contamination, Oceans, England, *Advisory Committee on Oil Pollution

Summary not available.

[from Nature 263(5575):v. 1976]

C-0309-77
COASTAL ZONE POLLUTION IN INDONESIA - A RECONNAISSANCE SURVEY
Anon. 1974.
Smithsonian Institution, Office of International and Environmental Programs; Contract AID/csd-2608. 203p.

Oil spills, Coasts, Indonesia, Environmental effects, Offshore drilling

Environmental impacts associated with international development led to the undertaking of the present joint study on oil and other pollution in Indonesia's coastal waters. A survey was made of offshore oil exploitation.

[from Government Reports Announcements 76(21):#PB-255 447/5GA. 1976]

C-0310-77
THE CRUDE OIL POLLUTION OF SAND BEACHES BY THE ACCIDENT OF A TANKER "THE JULIANA" OFF NIIGATA COAST IN 1971 [English summary]
Aoki, S., K. Chihara, I. Kobayashi, et al. 1975.
Niigata University, Science Reports, Series E(3):51-62.

Oil spills, Crude oil, Tankers, Beaches, Japan, *Niigata Coast

Summary not available.

[from Bibliography and Index of Geology 40(9):1364. 1976]

C-0311-77
MARINE ECOLOGY AND OIL POLLUTION
Baker, J. M. 1976.
Barking, Essex, Applied Science Publishers, Ltd., 1976. 566p.

Contamination, Marine organisms, *Marine ecology

Summary not available.

[from Nature 263(5574):xiv. 1976]

C-0312-77
WATER QUALITY PARAMETERS - A SYMPOSIUM
Canada Center for Inland Waters, and Chemical Institute of Canada. 1975.
Philadelphia, American Society for Testing and Materials, 1975.

Water quality, Oil spills, Environmental effects, Arctic, Canada

This book includes papers on the environmental impact of experimental oil spills in the Canadian Arctic. Other pollutants, such as pesticides and heavy metals, are covered.

[from On Effects of Oil Pollution in Arctic and Subarctic Waters. Northwest Marine Fisheries Center. September, 1976]

C-0313-77
THE HEALTH OF THE OCEANS
Goldberg, E. D. 1976.
Paris, The Unesco Press, 1976. 172p.

Contamination, Oceans, Hydrocarbons, *Marine pollutants, Environmental effects

Five kinds of major marine pollutants are identified: halogenated hydrocarbons, radioactivity, heavy metals, petroleum hydrocarbons and litter. Available information on quantities of each pollutant being mobilized about the earth is reviewed so as to evaluate man's impact on the marine environment.

[from IMC Newsletter No. 13:3. 1976]

C-0314-77
MINERAL OIL - A DANGER TO WATER AND AIR
Hess, W. 1973.
Gesundheitstechnik 9(6):130-132.

Pollution control, Oil transport, Storage, Production, Statistics

Various aspects of the production, consumption, and pollution hazards of oil are outlined, and the current oil pollution situation is examined with examples and statistics from Europe and North America. The author advocates drastic limits on oil consumption, improved pollution control in the storage and transport of oil, increased use of public transportation, and changes in production philosophy to promote durability rather than turnover.

[from Environmental Health and Pollution Control 10(6):#1286. 1976]

C-0315-77
OIL IN THE MARINE ENVIRONMENT
Ketchum, B. H. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.709-738.

Environmental effects, Environmental protection, Contamination, Marine organisms, Guidelines

Oil pollution in the marine environment is reviewed and specific recommendations for procedures to be followed to protect marine wildlife and to minimize damage to the marine biota are listed.

[from Selected Water Resources Abstracts 9(20):#W76-11025. 1976]

C-0316-77
THE IMPORTANCE OF OIL POLLUTION IN THE NORTH SEA
Korringa, P. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.739-743.

Biological effects, Oil spills, North Sea, Behavior, Fate, Cleanup

North Sea oil pollution is discussed with emphasis on the biological effects of oil in the marine environment, the behavior of oil in the sea, and the hazards of chemicals used to clean up oil spills.

[from Selected Water Resources Abstracts 9(20):#W76-11026. 1976]

C-0317-77
TROUBLE ON OILED WATERS (editorial)
Morgan, A. H. 1976.
Massachusetts Audubon 16(3):1-3.

Oil spills, Environmental effects, Health hazards, Aromatic hydrocarbons, Offshore exploration, Atlantic coast, *New England

The environmental and health effects of petroleum, oil spills, and aromatic hydrocarbons are reviewed and the long-term effects of oil exploration off New England are discussed. The views of the Massachusetts Audubon Society on this subject are stated.

C-0318-77
BACKGROUND PAPERS FOR A WORKSHOP ON INPUTS, FATES, AND EFFECTS OF PETROLEUM IN THE MARINE ENVIRONMENT, VOL. 2
National Academy of Sciences. 1973.
NTIS AD-783990.

Biological effects, Environmental effects, Marine organisms, Oil spills, Analytical techniques, Crude oil, Fate, Oceans

Studies on the effects of petroleum on the marine environment and the fate of petroleum in the ocean are presented. Analytical techniques are described; and the effects of oil spills on coast lines, biota, marine resources, and human health are discussed.

[from Selected Water Resources Abstracts 9(20):#W76-11007. 1976]

C-0319-77
BIOLOGICAL EFFECTS AND ENVIRONMENTAL ASPECTS OF 1,3-BUTADIENE
(Summary of the published literature)
Parsons, T. B., and G. E. Wilkins. 1976.
Final report, EPA/560/2-76/004. Contract EPA-68-01-3249. 58p.

Hydrocarbons, Biological effects, Environmental effects, Wastewaters, *1,3-butadiene

The report contains information on the effects of 1,3-butadiene in environmental samples and on the reactivity of 1,3-butadiene in environmental media.

[from Government Reports Announcements 76(19):#PB-253 982. 1976]

C-0320-77
FROM ESTHETICS TO ECOLOGY: THE EVOLVING ENVIRONMENTAL MOVEMENT
Peterson, R. W. 1976.
Catalyst for Environmental Quality 5(2):9-13.

Environmental deterioration, Oil spills, Tankers

Man's accelerating degradation of the worldwide environment is examined; specific environmental problems, such as the increasing damage of oil spillage from tankers and supertankers, are briefly reviewed.

C-0321-77
PARTITIONING OF MERCURY AND POLYCHLORINATED BIPHENYL BY OIL, WATER, AND SUSPENDED SEDIMENT
Saylor, G. S., and R. R. Colwell. 1976.
Environmental Science & Technology 10(12):1142-1145.

*Partitioning studies, *Mercury, *HCB, Crude oil, Sediments, Freshwater, Seawater

Mixtures of suspended sediment and/or crude oil in freshwater and marine systems were tested for partitioning of mercury and hexachlorobiphenyl (HCB) in the suspended sediment and oil. Radioactively labeled $^{203}HgCl_2$ and U-^{14}C 2,4,5,2',4',5'-hexachlorobiphenyl were added to media and analyzed. Results show that both oil and suspended sediment could partition mercury and HCB.

C-0322-77
OIL POLLUTION OF THE SEA - THE WORLD WIDE SCENE
Smith, J. W. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 26p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Oil spills, Tankers, Environmental effects, Pollution control, Cleanup, International conventions, Contingency planning

The magnitude, sources, and environmental effects of marine oil pollution are briefly reviewed and tabulated; accidental and operational pollution problems associated with tankers are emphasized. The major provisions of international conventions and voluntary tanker industry agreements pertinent to pollution control and cleanup funding are discussed. Cleanup methods are compared and the need for contingency planning is stressed.

C-0323-77
IMPACTS OF THE DEPOSITION OF DREDGED SPOILS ON LAKE ERIE SEDIMENT QUALITY AND ASSOCIATED BIOTA
Sweeney, R., R. Foley, C. Merckel, and R. Wyeth. 1975.
Journal of Great Lakes Research 1(1):162-170.

Chemical analysis, Sampling, Great Lakes, Sediments, Distribution, *Dredged spoils

Sediment samples were collected from 50 equally spaced stations in a 128 km^2 area of Lake Erie, which contained a former dump site for dredgings from Cleveland Harbor and the Cuyahoga River. Analysis of the samples for nutrients, heavy metals, and pollutants including oil and grease indicated a greater degree of pollution in sediments at the dump site than in surrounding sediments.

[from Chemical Abstracts 85(20):#146002d. 1976]

C-0324-77
WATER QUALITY CRITERIA RESEARCH OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY. PROCEEDINGS OF AN EPA-SPONSORED SYMPOSIUM ON MARINE, ESTUARINE AND FRESH WATER QUALITY -- PRESENTED AT THE 26TH ANNUAL MEETING OF THE AIBS, ON AUGUST 1975
U.S. Environmental Protection Agency. 1976.
EPA/600/3-76/079. 194p.

Hydrocarbons, Toxicity, Biodegradation, Water quality, Estuaries, Freshwater, Seawater, *EPA

Research programs conducted by research laboratories of the EPA Office of Health and Ecological Effects were presented. Topics included microbial and abiotic degradation processes, the effects of toxic organics, and the feasibility of new stress-measuring methodologies in the marine environment.

[from Government Reports Announcements 76(23):#PB-257 091/9GA. 1976]

C-0325-77
A STUDY TO DETERMINE THE LONG-TERM IMPACT OF THE ARROW SPILL
Vandermeulen, J. 1976.
Spill Technology Newsletter 1(3):14-15.

Environmental effects, Fuel oil, Oil spills, Shorelines, Marine organisms, Biodegradation, Canada, Chedabucto Bay

The long-term environmental effects of the 1970 ARROW oil spill into Chedabucto Bay, Nova Scotia, is the aim of a Bedford Institute of Technology research project which began in the summer of 1976. The amount and composition of residual Bunker C oil still remaining on the shores will be estimated and the biological effects of the oil on intertidal and marine organisms will be analyzed from both an ecological and physiological point of view. Biodegradation of the oil and physical modifications of the shoreline environment as a result of the spill and cleanup efforts will also be analyzed.

D. EFFECTS OF OIL EXPLORATION AND PRODUCTION

1. BIOLOGICAL EFFECTS

C-0326-77
POTENTIAL EFFECTS OF OIL DRILLING AND DUMPING ACTIVITIES ON MARINE BIOTA
George, R. Y. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, 1975. p.333-355. Proceedings.

Offshore drilling, Biological effects, Marine organisms, Oil spills, *Drilling mud components

Gaps in the present knowledge of the impact of drilling mud components on marine biota and the chronic effects of oil spills on both marine plants and animals are explored. Four aspects of offshore drilling activity are examined for their effects on marine ecosystems: (1) the 'burial effect' on the sea floor organisms caused by discharge of drilling mud components; (2) possible accumulation or magnification in the food chain of discharged drilling mud components; (3) influence of turbidity-plumes of drilling mud on filter feeding organisms; and (4) the acute and chronic effects of crude oil spillage on marine organisms.

[from Selected Water Resources Abstracts 9(17):#W76-08907. 1976]

C-0327-77
COASTAL MANAGEMENT ASPECTS OF OCS OIL AND GAS DEVELOPMENTS - TECHNICAL INFORMATION PAPER
Laroe, L. T., P. R. Stang, K. H. Conroy, D. W. [illegible], and T. O. Neill. 1975.
National Oceanic and Atmospheric Administration report, NOAA-76011504; PB-249751/9. 90p.

OCS, Offshore development, Socio-economic effects, Environmental effects, Environmental management, Bibliographies

The report presents an overview of Outer Continental Shelf (OCS) petroleum-related activities. Discussed are Federal OCS responsibilities and roles, offshore and onshore activities associated with OCS operations, socio-economic and environmental impacts derived from these activities, and suggestions for planning and management of OCS developments. An annotated bibliography describes OCS-related portions of the literature cited, and a directory is included of agencies and organizations involved with OCS oil and gas activities.

[from Scientific and Technial Aerospace Report. [illegible]:#N76-25648. 1976]

C-0328-77
OFFSHORE EFFECTS OF OIL AND GAS OPERATIONS
Mertens, E. W. 1976.
American Association for the Advancement of Science: Annual Meeting, 1976. 7p. Summary.

Offshore production, Biological effects, Marine organisms, Gulf of Mexico, Venezuela, Natural seepage, Santa Barbara Channel, Tar, Bermuda coast

Studies were conducted to determine the effects on marine life of the following: oil production at Timbalier Bay, Gulf of Mexico, and at Lake Maracaibo, Venezuela; natural oil seeps at Coal Oil Point, Santa Barbara, California, chronic exposure to tar balls along the Bermuda coastline; and conditions under offshore oil platforms in the Santa Barbara Channel. Chronic exposure to low levels of crude oil produces a negligible effect on marine life.

[from Pollution Abstracts 7(5):#76-04390. 1976]

C-0329-77
AN ANALYSIS OF THE MAIN SCIENTIFIC PAPERS DEALING WITH LONG TERM LOW LEVEL EFFECTS OF OIL POLLUTION
Onuf, C. P. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.655-670.

Biological effects, Offshore production, Fisheries, Crude oil, Toxicity, Louisiana

Although large scale oil operations have been developed in the Gulf Coast region of Louisiana, major fisheries along this offshore area have not experienced reduced yields in productivity. Some populations, therefore, can accommodate long term, low level intrusion of oil. For other areas such as estuaries this may not be the case.

[from Selected Water Resources Abstracts 9(20):#W76-11022. 1976]

C-0330-77
THE TOXICITY OF SOME FORMATION FLUIDS AND METHODS OF REHABILITATION SUBSEQUENT TO THEIR SPILLAGE
Shaw, D. R. 1976.
Journal of Canadian Petroleum Technology 15(3):37-41.

Toxicity, *Formation fluids, Drilling, Plants, *Land animals

The toxic effects of formation fluids to plant and animal life are assessed. Formation fluids are a complex mixture of hydrocarbons and salt water containing various amounts of sulfur compounds. The toxicity of the individual components and of the mixtures are considered, and recommendations for minimizing the environmental and biological effects of these substances are presented.

C-0331-77
EFFECTS OF OIL FIELD BRINE, DRILLING MUD, CUTTINGS AND OIL PLATFORMS ON THE OFFSHORE ENVIRONMENT
Shinn, E. A. 1975.
Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast, 1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p. 243-255. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Biological effects, Offshore drilling, Marine organisms

"A review with 10 references of the effect of petroleum drilling on marine organisms."

[from Chemical Abstracts 85(16):#112319x. 1976]

2. SOCIAL EFFECTS

C-0332-77
SOCIAL COST OF OIL POLLUTION
Mudjiardjo, H. S. 1976.
Master's thesis, Naval Postgraduate School. 66p.

Oil spills, Social effects, Environmental management

The thesis uses a simulation to consider the spread and damage caused by oil spills using data from San Francisco Bay. A projection of social costs from these spills is made. A methodology for deriving the social cost of oil spills is prerequisite in reaching rational decisions in managing oil pollution. Such decisions may include establishment of a fine structure, determination of the required level of cleanup, and identification of socially significant spills.

[from Government Reports Announcements 76(20):#AD-A027 257/5GA. 1976]

3. CHEMICAL EFFECTS

C-0333-77
LONG-TERM CHEMICAL EFFECTS OF PETROLEUM IN SOUTH LOUISIANA WETLANDS - I. ORGANIC CARBON IN SEDIMENTS AND WATERS
Whelan, T., III, J. T. Ishmael, and W. S. Bishop. 1976.
Marine Pollution Bulletin 7(8):150-155.

Chemical effects, Hydrocarbons, Sediments, Oil fields, Microorganisms, Louisiana, *Petroleum dissolution

Hydrocarbon levels and dissolved organic carbon content of sediments associated with two active oil fields in south Louisiana were measured, and the chemical effects of chronic petroleum input into a shallow water marsh were examined. Microbial processes were found to be responsible for dissolution of petroleum into dissolved carbon which may be a more significant measure of chronic petroleum input than hydrocarbon distribution.

4. ECONOMIC EFFECTS

C-0334-77
ECONOMIC ANALYSIS OF PROPOSED AND INTERIM FINAL EFFLUENT GUIDELINES OF THE OFFSHORE OIL AND GAS PRODUCING INDUSTRY
Arthur D. Little, Inc. 1975.
Report EPA -- 230/1-75-063. 247p.

Economic effects, Guidelines, Wastewater treatment, Offshore production, Alaska, Gulf of Mexico, California

An analysis is presented of the possible economic effects resulting from the application of effluent limitation guidelines to offshore production as required by the Federal Water Pollution Control Act. Capital investment will be required to bring Alaskan and Gulf of Mexico producing wells into compliance, but California wells will require little or no additional investments.

[from Energy Abstracts for Policy Analysis 2(7):#1159. 1976]

C-0335-77
OIL AND THE ENVIRONMENT - A CALIFORNIA CASE STUDY
Barnett, D. W. 1976.
Australian Petroleum Exploration Association Journal 16(1):137.

Economics, Models, Refineries, Oil spills, Biodegradation, California, *Crude oil costs

A computer programming model used to minimize crude oil costs in California refineries is discussed with particular attention given to oil spills, microbial degradation, and environmental standards.

[from Environment Abstracts 6(10):#76-06604. 1976]

C-0336-77
ECONOMIC IMPACT OF OIL RESOURCE DEVELOPMENT ON THE ALASKAN ECONOMY 1975-1985
Drake, R., and J. Younger. 1976.
U.S. Dept. of Commerce, Report FEA/B--76/087. PB-25 1660.
98p.

Alaska, Oil industry, Production, Economic effects

Quantitative estimates are presented of the economic impacts on Alaska of Alaskan petroleum development over the next decade. The study predicts large but erratic changes in Alaska's industrial output and work force over this period of time.

[from Energy Abstracts for Policy Analysis 2(8):#1384. 1976]

C-0337-77
ECONOMIC IMPACT OF EPA'S REGULATIONS ON THE PETROLEUM REFINING INDUSTRY. VOLUME 1. EXECUTIVE SUMMARY.
Hart, D., S. Sobotka, and W. Johnson. 1976.
Final report, EPA/230/3-76/004-1; Contract EPA-68-01-2830. 30p.

Refineries, Crude oil, Regulations, Economic effects, Wastewater treatment, Oil industry, *EPA

The regulations taken into account are air emissions, water effluent standards, and product quality. It is assumed that (1) price controls will lapse according to the current legislated schedule, and (2) continued tariff protection to insure the growth of petroleum product consumption in the U.S. will be provided to U.S. refineries.

[from Government Reports Announcements 76(18):#PB-253 759/5GA. 1976]

C-0338-77
ECONOMIC IMPACT OF EPA'S REGULATIONS ON THE PETROLEUM REFINING INDUSTRY. VOLUME 2. PART ONE AND TWO. INDUSTRY DESCRIPTION AND TECHNICAL ANALYSIS. VOLUME 3. PART THREE. ECONOMIC IMPACT ANALYSIS
Hart, D., S. Sobotka, and W. Johnson. 1976.
Final report, EPA/230/3-76/004-2; EPA/230/3-76/0004-3. Contract EPA-68-01-2830. 210p; 210p.

Refineries, Crude oil, Regulations, Economic effects, Wastewater treatment, Oil industry, *EPA

The EPA regulations taken into account in these two volumes are air emissions, water effluent standards, and product quality (lead in gasoline and residual fuel oil desulfurization).

[from Government Reports Announcements 76(18):PB-253 760/3GA; PB-253 761/1GA. 1976]

C-0339-77
SECTION 4: IMPACT OF SPILLS AND CLEANUP TECHNOLOGY ON LIVING NATURAL RESOURCES AND RESOURCE-BASED INDUSTRY
Scarratt, D. J. 1974.
Summary of Physical, Biological, Socio-economic and Other Factors Relevant to Potential Oil Spills in the Passamaquoddy Region of the Bay of Fundy. Fisheries Research Board of Canada Technical Report 428. p.141-158.

Economic effects, Oil spills, Fisheries, Canada, Cleanup, Ports, *Bay of Fundy

Fisheries of the Bay of Fundy region would be particularly sensitive to the effects of oil spills or oil pollution from an oil port site in the Passamaquoddy Bay region. The unstable economics of existing fisheries, and the prohibitive cost and difficulty of providing adequate protection against oil spills would adversely affect this resource-based industry.

[from Baseline Study Program North Puget Sound. Biological Oil Impact Literature Review. Volume II. Bibliography. No. PB-254 292.]

C-0340-77
ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES: PETROLEUM REFINING INDUSTRY
U.S. Environmental Protection Agency. 1974.
Final report, EPA--230/2-74/020; PB--239336. 86p.

Economic effects, Guidelines, Refineries, Wastewater treatment, Regulations, *FWPCA

This report provides a basis for evaluating the broad economic effects of the application of effluent limitations guidelines and standards of performance that were established by EPA pursuant to provisions of the Federal Water Pollution Control Act (FWPCA).

[from Energy Abstracts for Policy Analysis 2(7):#1127. 1976]

6. GENERAL EFFECTS

C-0341-77
CURRENT OIL SANDS PRODUCTION METHODS GULP AND POLLUTE TOO MUCH WATER
Anon. 1974.
Canadian Petroleum 15(9):37-38.

Production, Tar sands, Contamination, Water quality, Canada, *Athabasca oil sands

"Large scale development of the Athabasca oil sands calls for larger volumes of water and larger storage (settling) areas for the used water than are presently available. To meet this difficulty, the extraction of the bitumen by direct coking of oil sands in a fluidized bed reactor is proposed. Earlier work in this direction is summarized."

[from Fuel Abstracts: 17(6):#3954. 1976]

C-0342-77
MARITIME ADMINISTRATION TITLE 11. VESSELS ENGAGED IN OFFSHORE OIL AND GAS DRILLING OPERATIONS. FINAL ENVIRONMENTAL IMPACT STATEMENT
Anon. 1976.
Maritime Administration report, MA-EIS-7302-76015F; PB-248857/5. 370p.

Offshore drilling, Environmental effects, Economics, EIS, *Drilling vessels

"Floating offshore oil and gas drilling units, and their support vessels are described. A general description is given of the marine environment, the possible impact on the environment that program vessels could have and the alternatives to Title 11 financing of such vessels."

[from Scientific and Technical Aerospace Reports 14(16):#N76-25603. 1976]

C-0343-77
OFFSHORE EUROPE '75 CONFERENCE, PREPRINTS
Anon. 1975.
Offshore Europe '75 Conference, Aberdeen, Scotland, 1975. Aberdeen, Scotland, Spearhead Publishers Ltd., 1975. Preprints.

Offshore development, Offshore drilling, Europe, Oil transport, Regulations, Oil spills

This conference focused on offshore oil operations in northwestern Europe with particular emphasis on oil drilling and transport, government regulations, and the effects of oil spills on the marine environment.

[from The Engineering Index Monthly 14(9):#061761. 1976]

C-0344-77
UNIVERSITY OF ALASKA PARTICIPATES IN STUDIES (news brief)
Anon. 1976.
Offshore 35(12):196,198.

Offshore development, OCS, Environmental effects, U.S. Government, Alaska

The University of Alaska has been conducting research on the Outer Continental Shelf areas of Alaska as part of the federal government's OCS environmental assessment program. Six university units are involved in the projects to gather environmental baseline data in nine areas off Alaska which the federal government proposes to open to oil development.

C-0345-77
SHETLAND ENVIRONMENTAL SEMINAR (editoral)
Bourne, W. R. P. 1976.
Marine Pollution Bulletin 7(9):161-163.

Oil industry, Oil spills, Environmental effects, Production, Scotland, *Shetland Islands, *Sullom Voe

The recent history of the Sullom Voe Environmental Advisory Group (SVEAG) and oil pollution in the Shetland Islands is reviewed, and conflicts between the inhabitants [illegible] the islands and British Petroleum are discussed. Oil spill controls and environmental impacts of developing oil production are described.

C-0346-77
ENVIRONMENTAL DIFFICULTIES ENCOUNTERED IN SHALE OIL PRODUCTION
Davidson, J. W. 1976.
Alternate Fuels Symposium, 1976. Abstract.

Oil shale development, Environmental effects, Groundwater, *Streams

Potential pollution to surface streams and groundwater from above-ground shale retorts is discussed.

[from Pollution Abstracts 7(5):#76-04321. 1976]

C-0347-77
THE SEPARATION OF OIL FROM WATER FOR NORTH SEA OIL OPERATIONS
Department of the Environment, Central Unit on Environmental Pollution. 1976.
London, Her Majesty's Stationery Office, 1976. 34p. (Pollution Paper No. 6)

Offshore production, North Sea, Biological effects, Behavior, Monitoring, Pollution control

The sources and quantities of oil pollution expected from North Sea oil production are assessed, and behavior and biological effects of oil pollution are discussed. Available technology for measuring and monitoring oil contamination and for oil-water separation and wastewater treatment are reviewed. Recommendations for reducing and controlling oil discharges from onshore and offshore facilities are given.

[from Water Research Centre Information 3(40):#76-2785G. 1976]

C-0348-77
PETROLEUM PRODUCTION AND POLLUTION POTENTIAL IN THE CARIBBEAN SEA AND THE GULF OF MEXICO
Emery, K. O., and E. Uchupi. 1974.
Pacem in Maribus, Caribbean Study Project. Malta University Press, 1974. p.22-42. Working papers and selection from dialogue at preparatory conference, Jamaica, 1972.

OCS, Caribbean Sea, Offshore production, Pipelines

Core sediments and shallow water depths in the Caribbean Sea indicate that the continental shelves of North and South America are the best areas for production of oil and gas. Pollution of the shores appears to be minimal because of the wide use of pipelines and departure of tankers in full condition. The geologic history of the area with charts showing current (1971) leases and areas of production is reviewed.

[from Aquatic Sciences and Fisheries Abstracts 6(4):#6Q3817. 1976]

C-0349-77
ATHABASCA OIL SANDS: FIRST REGIONAL CONFERENCE, WESTERN REGION ENGINEERING INSTITUTE OF CANADA
Engineering Institute of Canada. 1974.
Montreal, Engineering Institute of Canada, 1974. 434p.

Tar sands, Extraction, Production, Environmental effects, Wastewater disposal

The proceedings comprises 26 papers on various aspects of the development of a tar sands industry, including geology of the deposits, mining and processing technology, waste disposal, water requirements, and environmental impact of development and extraction processes.

[from Energy Abstracts for Policy Analysis 2(9):# 1573. 1976]

C-0350-77
EXXON AND THE ENVIRONMENT
Exxon Corporation. 1975.
New York, Public Affairs Dept., Exxon Corporation, 1975. 128p.

Conservation, Oil industry, *Exxon, Offshore production, Oil spills, Tankers, Environmental protection

Exxon's environmental conservation efforts are presented in this anthology of articles. Topics covered include refineries; terminals; offshore production problems; tankers; oil spills and spill prevention; oil ports; exploration and development in the Arctic; and numerous articles on oil, the oil industry, and its interaction with the environment.

[from Energy Abstracts for Policy Analysis 2(9):#1474. 1976]

C-0351-77
THE ARCTIC COASTAL ENVIRONMENT OF ALASKA. VOLUME 1. THE NEARSHORE MARINE ENVIRONMENT IN PRUDHOE BAY, ALASKA
Feder, H. M., D. G. Shaw, and A. S. Naidu. 1976.
No. IMS-R76-1, Sea Grant-76-3; NOAA-76060210. 167p.

Hydrocarbons, Marine organisms, Sediments, Coasts, Prudhoe Bay, Alaska

The results of biological, geological, and hydrocarbon chemistry investigations conducted near the site of a causeway construction project on the west side of Prudhoe Bay are reported. Hydrocarbon levels in the biota and in the sediments were determined.

[from Government Reports Announcements 76(23):#PB-257 353/3GA. 1976]

C-0352-77
ONSHORE IMPACT OF OFFSHORE DEVELOPMENT NEEDS TO BE HANDLED WITH CARE AND PLANNING
Franssen, H. T. 1976.
Offshore 36(5):352-376.

Oil spills, Coasts, Offshore development, OCS, Environmental protection, Socio-economic effects

Oil development, spills from blowouts, environmental safety, spill technology, and near-shore effects of outer continental shelf developments on the coastal zone of the U.S. are discussed. A historical perspective is presented and socio-economic effects are considered.

C-0353-77
AN ENVIRONMENTAL PROGRAM FOR A COMMERCIAL SHALE OIL COMPLEX
Kilburn, P. D., and M. W. Legatski. 1974.
American Institute of Mining, Metallurgical and Petroleum Engineers Proceedings, 1974. p.19-31. (Annual Minerals Symposium, No. 17.)

Oil shale development, Environmental management, Extraction, Environmental protection

Summary not available.

[from Bibliography and Index of Geology 40(7):935. 1976]

C-0354-77
THE RESPONSIBILITIES AND ENVIRONMENTAL PROGRAMS OF THE U.S. GEOLOGICAL SURVEY IN THE BALTIMORE CANYON TROUGH AREA
Knebel, H. J., and N. S. Hardin. 1975.
Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast, 1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p.7-17. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Offshore development, Environmental protection, Atlantic coast, Government agencies, *U.S. Geological Survey

Summary not available.

[from Bibliography and Index of Geology 40(7):935. 1976]

C-0355-77
OIL IN SEA ICE
Lewis, E. L. 1976.
Pacific Marine Science Report 76(12). 26p.

Drilling, Oil spills, Movement, Beaufort Sea, Canada, *Oil-on-ice

Environmental information was acquired on the Beaufort Sea to assess the effects of oil drilling north of the Mackenzie Delta, N.W.T. A discussion on the formation and structure of sea ice and the movement of spilled oil on an ice-water interface is presented.

[from Selected Water Resources Abstracts 9(20):#W76-11098. 1976]

C-0356-77
DECISIONS FOR DELAWARE: SEA GRANT LOOKS AT LEGAL ASPECTS OF OCS DEVELOPMENT
Mangone, G. J., and J. Homer. 1975.
University of Delaware Sea Grant Program report, DEL-SG-1-75(2). 24p.

Legislation, U.S., Offshore development, OCS, Delaware, Liability, Oil spills, Environmental protection

Federal legislation, legal restrictions, and jurisdiction over outer continental shelf development on the Atlantic seaboard off Delaware are examined. Ecological management schemes, environmental protection enforcement, and oil spill liability assessment are among the topics considered.

[from Oceanic Abstracts 13(5):#76-04999. 1976]

C-0357-77
ENVIRONMENTAL PROTECTION AGENCY'S ROLE, INTERESTS AND RESPONSIBILITIES WITH RESPECT TO THE OUTER CONTINENTAL SHELF DEVELOPMENT
McErlean, A. 1975.
Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast, 1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p.3-5. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Offshore development, Environmental protection, Atlantic coast, Government agencies, *EPA

Summary not available.

[from Bibliography and Index of Geology 40(7):937. 1976]

C-0358-77
OFFSHORE ACTIVITIES AND THE ENVIRONMENT
McGill, S. R., and I. A. Spottiswood. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute EnvironmentalConservation Executive, 1976. 14p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Offshore development, Environmental protection, Safety, Offshore production, Australia

ESSO Australia Ltd's programs for environmental protection in offshore oil-related activities are reviewed using examples from existing company facilities in the Bass Straits off southern Australia. Careful planning for safety and environmental compatibility is stressed for all aspects of exploration, formation, evaluation, design, installation, and operation of production and oil transfer facilities.

C-0359-77
THE ENVIRONMENTAL STUDIES PROGRAM OF THE BUREAU OF LAND MANAGEMENT
Monastero, F. C. 1975.
Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast, 1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p.1-2. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Offshore development, Environmental protection, Atlantic coast, Government agencies, *BLM

Summary not available.

[from Bibliography and Index of Geology 40(7):937-938. 1976]

C-0360-77
CANADA OIL SANDS AND OIL COMPANIES
Paehlke, R. 1976.
Environment 18(9):2-4.

Tar sands, Development, Canada, Socio-economic effects, Environmental effects

The heavy oils and oil sands of Northern Alberta are the subject of this overview. The environmental, social, and economic problems associated with oil sands development are discussed.

C-0361-77
FLORIDA COASTAL POLICY STUDY: THE IMPACT OF OFFSHORE OIL DEVELOPMENT
Pearman, A. L., and J. W. Stafford. 1976.
Final report, Florida State University, Tallahassee; Department of Urban and Regional Planning. 284p.

Environmental effects, Socio-economic effects, Offshore development, Coasts, Florida, Guidelines, *Onshore effects

The environmental, economic, social, and legal impacts of possible offshore oil and gas development on coastal Florida are analyzed. The onshore impacts of similar developments in other coastal areas are considered. Policy alternatives are developed as guidelines for minimizing adverse effects of such activities.

[from Scientific and Technical Aerospace Reports 14(17):#N76-26672. 1976]

C-0362-77
ENVIRONMENTAL CONTROL FOR OIL SHALE PROCESSING
Powers, T. J. 1976.
EPA National Conference on Health, Environmental Effects, and Control Technology of Energy Use, Washington, D.C., 1976. 5p.

Oil shale development, Environmental protection, Wastewaters, Pollution control, Government agencies, *EPA

EPA sponsored environmental research and development in oil shale processing emphasizes the characterization of air, water, and solid waste discharges, and the evaluation and development of present and future environmental control methods.

[from Environmental Abstracts 6(7/8):#76-04831. 1976]

C-0363-77
IDENTIFICATION AND ANALYSIS OF MID-ATLANTIC ONSHORE OCS IMPACTS
Resource Planning Associates, Inc. 1976.
RA-75-46C, FEA/G-76/279; Contract FEA-CA-05-50078-00. 284p.

Offshore development, OCS, Atlantic coast, *Onshore impacts, Environmental effects, Socio-economic effects

Recent literature on the onshore socio-economic and environmental impacts related to OCS oil and gas recovery is evaluated. Required management decisions and policy choices for the next decade are addressed and additional study needs are recommended.

[from Government Reports Announcements 76(20):#PB-254 925/1GA. 1976]

C-0364-77
OUTER CONTINENTAL SHELF (OCS) OIL AND GAS. AN ENVIRONMENTAL ASSESSMENT. VOL. 4. POTENTIAL ONSHORE EFFECTS OF OIL AND GAS PRODUCTION ON THE ATLANTIC AND GULF OF ALASKA OUTER CONTINENTAL SHELF
Resource Planning Associates, Inc. 1974.
Final report, Contract EQ4AC002. PB--239266. 626p.

Environmental effects, *Onshore effects, Offshore production, OCS, Gulf of Alaska, Atlantic coast

"Potential onshore effects of oil and gas production on the Atlantic and Gulf of Alaska Outer Continental Shelf (OCS) are discussed. Socio-economic and environmental conditions of onshore development, given no OCS development, and impacts that could occur if OCS resources are developed are covered."

[from Energy Abstracts for Policy Analysis 2(7):#1163. 1976]

C-0365-77
OIL SHALE; AN ENVIRONMENTAL ASSESSMENT
Scrudato, R. J. 1975.
Geological Society of America, Abstracts with Programs 7(2):233.

Oil shale development, Production, Extraction, Environmental effects

Extraction of oil from oil shales by conventional surface and/or subsurface mining followed by in situ surface retorting creates immediate and long-term environmental problems. Various conventional and nonconventional oil shale production processes and environmental considerations are discussed in light of currently available information.

C-0366-77
RESPONSIBILITY OF OFFSHORE DRILLING REGULATIONS
Solanas, D. W. 1975.
Environmental Aspects of Chemical Use in Well-drilling Operations, 1975. p.571-575. Proceedings.

OCS, Offshore drilling, Offshore production, Regulations, Government agencies, *U.S.G.S

The paper reviews areas of responsibility of the U.S. Geological Survey in regulating outer continental shelf oil and gas drilling and production operations. The responsibility for safe operation is primarily the responsibility of the lessee of the site.

[from Selected Water Resources Abstracts 9(17):#W76-08918. 1976]

C-0367-77
THE ENVIRONMENT AND THE OFFSHORE OIL INDUSTRY IN SCOTTISH WATERS - A REVIEW. PART 1. THE DEVELOPING MARITIME GEOGRAPHIC PATTERNS
Smith, H. D. 1976.
Maritime Studies and Management 3(4):205-215.

Environmental effects, OCS, Offshore development, Offshore production, Oil industry, Coasts, Fisheries, Scotland

Maritime geographic patterns in Scottish waters, which are evolving concurrently with development of the offshore oil industry, are examined with emphasis on the coastal and marine environment. Each phase of offshore oil and gas development - exploration, manufacture and installation of production facilities, and production - impacts the environment in different ways. In Scotland, the exploration phase and installation of production platforms and pipelines has already impacted the fishing industry. See also Part 2; C-0368-77.

[from Selected Water Resources Abstracts 9(22):#W76-11945. 1976]

C-0368-77
THE ENVIRONMENT AND THE OFFSHORE OIL INDUSTRY IN SCOTTISH WATERS - A REVIEW. PART 2. THE REGIONAL PATTERN OF DECISION MAKING
Smith, H. D. 1976.
Maritime Studies and Management 3(4):217-220.

Environmental effects, Social effects, Offshore development, Scotland, Conservation, Oil industry

The relationship between regional decision-making and environmental factors are explored, with emphasis on conflicts of interest between environmental conservation and regional industrial development. Specific environmental issues of three regions which receive the greatest social and environmentalimpacts from oil development - northeast Scotland, Cromarty Firth, and Shetland - are enumerated and discussed. See also Part 1; C-0367-77.

[from Selected Water Resources Abstracts 9(22):#W76-11946. 1976]

C-0369-77
FINAL ENVIRONMENTAL STATEMENT: OIL AND GAS DEVELOPMENT IN THE SANTA BARBARA CHANNEL OUTER CONTINENTAL SHELF OFF CALIFORNIA
U.S. Geological Survey. March, 1976.
USGS special report, FES-13, Vol. 1-3. 2056p.

EIS, Offshore development, OCS, Environmental effects, Oil-gas leasing, Santa Barbara Channel, *USGS

The offshore and onshore environmental impacts of various possible levels of OCS oil and gas development in the Santa

Barbara Channel federal lease areas are assessed. Four alternative options of such development are : (1)continued production at present rates; (2) increased production from currently developed leases; (3) exploration and development of all existing leases; and (4) leasing, exploration, and development of presently unleased areas. Potential activities that these alternatives entail are discussed; unavoidable adverse onshore and offshore environmental effects of these development options are evaluated, and measures for mitigating adverse environmental impacts are considered.

C-0370-77
IMPROVEMENTS IN ENERGY TRANSPORTATION TECHNOLOGY AND IMPACT OF ENERGY TRANSPORTATION ON THE ENVIRONMENT
Watterson, S. E., Jr. 1974.
The Economic and Environmental Challenges of Future Energy Requirements; General Reports. London, World Energy Conference, 1974. "variously paginated"

Environmental effects, Oil transfer, Oil transport, Pipelines, Tankers

Summary not available.

[from Bibliography and Index of Geology 40(8):1153. 1976]

C-0371-77
DRAFT ENVIRONMENTAL IMPACT REPORT FOR RESUMPTION OF DRILLING IN THE SANTA BARBARA CHANNEL FROM EXISTING STANDARD OIL COMPANY OF CALIFORNIA PLATFORMS
Woodward-Clyde Consultants. 1976.
Report E-0021. 548p.

EIS, Environmental effects, Socio-economic effects, Oil spills, Pipelines, Tankers, Offshore production, Santa Barbara Channel

Existing environmental conditions in the Summerland and Carpinteria, California, offshore fields are summarized. Potentially significant environmental and socio-economic impacts and measures to mitigate adverse impacts are analyzed. The potential occurrence, movement, fate, and effects of oil spills from offshore platforms, onshore facilities, marine terminals, pipelines, and tankers within the proposed site are examined.

[from Environment Abstracts 6(7/8):#76-05076. 1976]

C-0372-77
OIL SHALE
Yen, T. F., and G. V. Chillingarian (eds.). 1976.
Amsterdam, Elsevier, 1976. 292p. (Developments in Petroleum Science, Vol. 5)

Oil shale, Distribution, Oil shale development, Environmental effects, Colorado

This book provides background information on the origin, distribution, mineralogy, chemistry, exploration, engineering, and environmental aspects of oil shale. It includes an environmental analysis of an oil shale industry in the upper Colorado region.

[from New Technical Books 61(8):#1166. 1976]

C-0373-77
EFFECTS OF DRILLING OPERATIONS ON THE MARINE ENVIRONMENT
Zingula, R. P. 1975.
Environmental Aspects of Chemical Use in Well-drilling Operations, 1975. p.433-488. Proceedings.

Environmental effects, Biological effects, Offshore drilling, Marine organisms

Exxon scientists studied the effects of offshore drilling operations on the marine environment. Suspended drilling solids were found to decrease very rapidly in a short distance from the drilling rig, mobile organisms were active on and around borehole cutting accumulations, and the cuttings were found to turn into "normal" sea bottom in several months. Chemicals normally used in drilling were found to interact with and become diluted in sea water. No adverse effects are reported.

[from Selected Water Resources Abstracts 9(17):#W76-08909. 1976]

E. FATE OF OIL IN THE ENVIRONMENT

1. BIODEGRADATION

C-0374-77
FUNGAL DEGRADATION OF OIL IN THE MARINE ENVIRONMENT
Ahearn, D. G., and S. P. Meyers. 1976.
Recent Advances in Aquatic Mycology. E. B. G. Jones (ed.).
New York, John Wiley and Sons, Halstead Press, 1976. p.125-133.

Biodegradation, Hydrocarbons, Fungi, Yeasts, Metabolism

The assimilation and degradation of oil fractions by fungi, and the effects of petroleum hydrocarbons on fungal ecology in aquatic regions are discussed. Hydrocarbonoclastic yeasts appear to be widespread in neritic environments and occur in high densities in surface slicks. Chronic oil pollution selectively stimulates certain indigenous strains of yeasts; however, common marine yeasts, such as *Rhodotorula*, *Debaryomyces*, and members of the *Candida lipolytica* complex, and common marine molds, such as *Cladosporium* and *Cephalosporium*, have relatively low oil assimilating capacities.

[from Oceanic Abstracts 13(5):#76-04618. 1976]

C-0375-77
BIODEGRADATION OF OIL ON WATER SURFACES
Bartha, R., and R. M. Atlas. 1976.
U.S. Patent 3,959,127

Biodegradation, Oil spills, Microorganisms, Cleanup, *Nutrient addition

A process is described which stimulates and accelerates the microbial degradation of spilled oil by providing essential microbial nutrients such as phosphates and nitrates. The necessary nutrients are in the form of a paraffinized urea slow-release fertilizer which dissolves in or is adsorbed by the oil.

[from Selected Water Resources Abstracts 9(22):#W76-11844. 1976]

C-0376-77
MAGNIFICENT MICROBES
Dixon, B. 1976.
New York, Atheneum, 1976. 251p.

Biodegradation, Oil spills, Cleanup, Ballast, Bilges, Oil tanks, Wastewater treatment, Reclamation, Petroleum products

The ubiquity and vital importance of microbes are discussed, with emphasis on the harnessing of microbes for a broad range of beneficial industrial and other applications. Included is a brief review of the use of bacteria in biodegrading oil spills, cleaning oil tanks, biodegrading oily ballast and bilge waters, and converting waste petroleum products into usable petroleum products, petrochemicals and proteins.

C-0377-77
MICROBIAL INTERACTION WITH OIL IN THE MARINE ENVIRONMENT
Floodgate, G. D., D. F. Gibb, and K. P. Pugh. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.507-515.

Biodegradation, Crude oil , Microorganisms, Bacteria, Cleanup, Monitoring, Oil spills

Microbial degradation of crude oil and its derivatives in the marine environment was studied with two separate aims: to use microorganisms as a means of removing spilled oil by seeding the surface water with hydrocarbonoclastic strains of bacteria; and to examine natural populations of microorganisms on oil spilled under various hydrographic and climatic conditions.

[from Selected Water Resources Abstracts 9(20):#W76-11015. 1976]

C-0378-77
THE RATE OF MICROBIAL DEGRADATION OF OIL IN A BEACH GRAVEL COLUMN
Gibbs, C. F., and S. J. Davis. 1976.
Microbial Ecology 3(1):55-64.

Biodegradation, Crude oil, Oxidation, Microorganisms, Beaches, Monitoring

A continuous flow respirometer was used to monitor the bio-oxidation of a crude oil in a column of coarse beach material. A number of water percolation rates were employed with and without nutrient supplementation. The oxidation rate increased with nutrient supplementation in the proportion of 0.23 mg oxidation per μmol nitrate.

C-0379-77
SOME REFLECTIONS ON THE BIODEGRADATION ON MINERAL OILS IN THE MARINE ENVIRONMENT
Gunkel, W. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.516-540.

Biodegradation, Decomposition, Crude oil, Microorganisms, *Mineral oil

Limiting factors of oil decomposition are discussed; the main problems encountered in studies regarding the biodegradation of mineral oils in the marine environment are outlined.

[from Selected Water Resources Abstracts 9(20):#W76-11016. 1976]

C-0380-77
PHOSPHORUS REQUIREMENTS OF BACTERIA WHICH METABOLIZE HYDROCARBONS AT SEA [in French]
LePetit, J., and M. H. N'Guyen. 1976.
Canadian Journal of Microbiology 22(9):1364-1373.

Biodegradation, Hydrocarbons, Metabolism, Bacteria, *Phosphorus requirements

The artificial stimulation of biodegradation of pollutant hydrocarbons requires a phosphorus supply between 2 and 8 X 10^{-4} M for waters with average salinity, and between 1.5 and 3 X 10^{-3} M for waters with below average salinity. Inhibition of the biodegrading process occurs with higher phosphorus concentrations than those stated above.

[from Petroleum Abstracts 16(47):#227,226. 1976]

C-0381-77
BIODEGRADATION OF POLYNUCLEAR AROMATIC HYDROCARBON POLLUTANTS BY SOIL AND WATER MICROORGANISMS
McKenna, E. J., and R. D. Heath. 1976.
Illinois University, Urbana - Champaign. Water Resources Center, UILU-WRC-76-0113, W76-08752, OWRT-A-073-ILL(1). 33p.

Biodegradation, Aromatic hydrocarbons, PAH, Microorganisms, Soil, *Waters

This study examines the structural limits of polynuclear aromatic hydrocarbon (PNA) degradation by measuring initial rates of hydrocarbon oxidation by soil and water microorganisms. Extensive amounts of potentially carcinogenic PNA's can be effectively removed by very dilute microbial suspensions found in natural waters.

[from Government Reports Announcements 76(17):#AD-253 964/1GA. 1976]

C-0382-77
MICROBIAL DEGRADATION OF OIL AND PETROCHEMICALS IN THE SEA
McKenzie, P., and D. E. Hughes. 1976.
Microbiology in Agriculture, Fisheries and Food. F. A. Skinner, and J. G. Carr (eds.). London, Academic Press, 1976. p.91-108.

Biodegradation, Crude oil, Petrochemicals, Bacteria

The biodegradation of crude oil and hydrocarbons under natural and simulated marine conditions, and the roles of environmental factors in the control of biodegradation are described. Gram negative bacteria of the genera *Pseudomonas* and *Achromobacter* were found to be very important in the degradation process; temperature, oxygen, and nutrient concentrations governed the rate of oil degradation. The influences of wave action, surfactants, detergents, and sinking agents on biodegradation are discussed.

[from Aquatic Sciences and Fisheries Abstracts 6(9):#6Q9838. 1976]

C-0383-77
BIODEGRADATION OF CELLULOSIC SUBSTRATES
Meyers, S. P. 1976.
Final report, Contract N00014-69-A-0211-0006. 15p.

Biodegradation, Hydrocarbons, Microorganisms, Oil spills, *Cellulosic substrates

This report examines the mechanisms for accelerated biodegradation of cellulosic substrates, especially analyses and optimization of pretreatment of the fiber prior to microbial digestion. Enzymatic activities of specific microorganisms have been studied, along with effects of specific pollutants (including crude oil and petroleum hydrocarbons) on in situ processes. Data suggest that selected physical/biodegradative techniques can be developed to accelerate cellulose decomposition rates in the aqueous environment.

[from Government Reports Announcements 76(18):#AD-A026 401/0GA. 1976]

C-0384-77
ASSIMILATION OF OIL BY SOIL BACTERIA
Raymond, R. L., J. O. Hudson, and V. W. Jamison. 1976.
American Petroleum Institute, Refining Department, No. 54.
p.429-455. Proceedings.

Biodegradation, Metabolism, Bacteria, Soil, Waste oil, Fuel oil, Crankcase oil, Crude oil, Groundwater

Six different types of oil, including two used crankcase oils, two crude oils, fuel oil, and a residual fuel oil, were applied to test plots of plowed, disked and fertilized soil. Monthly samples were taken for one year. Bacterial populations after one year were 1-2 orders of magnitude higher than before application of oil. Bacterial decomposition ranged from 57.8% for the residual fuel oil to 87.3% for heating oil No. 2.

[from Chemical Abstracts 85(20):#148549m. 1976]

C-0385-77
USE OF PETROLEUM HYDROCARBONS BY FUNGI [English summary]
Redchits, T. I. 1976.
Mikrobiologiya Zhurnal (Kiev) 38(2):244-251.

Biodegradation, Hydrocarbons, Metabolism, Microorganisms, Fungi, Bibliographies

The biodegradation and metabolism of petroleum hydrocarbons are reviewed, and 158 references are included.

[from Chemical Abstracts 85(3):#18857v. 1976]

C-0386-77
THE CONDITIONS FOR BIODEGRADATION OF PETROLEUM HYDROCARBONS AT SEA
Tagger, S., L. Deveze, and J. LePetit. 1976.
Marine Pollution Bulletin 7(9):172-174.

Biodegradation, Hydrocarbons, Oceans, Bacteria, Refineries

Ocean areas chronically polluted by hydrocarbons show high rates of petroleum degradation due to abundant bacterial development. This degradation is also a function of refinery effluent characteristics such as salinity, temperature, and nutrients.

C-0387-77
HYDROCARBON DEGRADATION BY OCEAN SEDIMENT BACTERIA
Walker, J. D., J. J. Calomiris, and R. R. Colwell. 1974.
Annual Meeting of the American Society for Microbiology, 74th, Chicago, Illinois, 1974. p.64. No. G269. Abstract.

Biodegradation, Hydrocarbons, Atlantic Ocean, Bacteria, Sediments, Seawater

Water and sediments collected in the Atlantic Ocean at depths from 9m to 5,000m were measured for hydrocarbons, and microorganisms in some sediment samples were examined for their ability to degrade petroleum hydrocarbons in seawater and saline solution. Sediment inocula from the 5,000m station demonstrated greater growth and hydrocarbon degradation when cultured in seawater than in synthetic saline medium. Samples from two stations yielded significantly less net bacterial growth in a petroleum-seawater medium than in a seawater medium without petroleum.

C-0388-77
OIL, MERCURY, AND BACTERIAL INDICATORS
Walker, J. D., and R. R. Colwell. 1976.
Environmental Science & Technology 10(12):1145-1147.

Biodegradation, Contaminants, Metabolism, Bacteria, Harbors, Chesapeake Bay, *Mercury inhibition

Several bacterial strains were isolated from an oil-contaminated creek in Baltimore Harbor, Chesapeake Bay, and were examined for ability to utilize oil with and without mercury added to the culture medium. Relatively low concentrations of mercury inhibited the utilization of oil by strains of bacteria studied.

C-0389-77
BIODEGRADATION RATES OF COMPONENTS OF PETROLEUM
Walker, J. D., R. R. Colwell, and L. Petrakis. 1976.
Canadian Journal of Microbiology 22(8):1209-1213.

Biodegradation, Crude oil, Hydrocarbons, Analytical techniques, Spectrometry

Computerized mass spectrometry was used to determine rates of microbial biodegradation of components of South Louisiana crude oil. Total oil residues descreased exponentially with time, whereas resins and asphaltene fractions increased at the logarithmic phase of growth. Saturated compounds decreased steadily during growth. Microbial degradation of these components was concluded to be a dynamic process.

[from Chemical Abstracts 85(17):#119430k. 1976]

2. PHYSICAL CHANGES OF OIL

C-0390-77
SEDIMENTATION PROCESSES INVOLVING HYDROCARBONS IN THE MARINE ENVIRONMENT
Gebelein, C. D. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.462-474.

Sedimentation, Hydrocarbons, Oil slicks, Evaporation, Adsorption, *Subtidal environments

Processes leading to increased density and, therefore, deposition of oil in subtidal environments include: modification of oil slicks by evaporation and dissolution of lighter materials, agglutination of dispersed particles, uptake of particulate matter by the oil, and adsorption of dissolved species into particulate matter.

[from Selected Water Resources Abstracts 9(20):#W76-11012. 1976]

C-0391-77
BEHAVIOR OF OIL UNDER CANADIAN CLIMATIC CONDITIONS. PART 1. OIL ON WATER UNDER ICE-FORMING CONDITIONS
Scott, B. F., and R. H. Chatterjee. 1975.
Department of the Environment, Ottawa. Scientific Series No. 50. 28p.

Oil spills, Behavior, *Freezing conditions, Evaporation, Biological effects, Marine organisms

Experiments were conducted at Shirley's Bay Quiet Site near Ottawa in order to determine the effects of freezing temperatures on the behavior of an oil spill. In this experiment, nearly 30% by weight of the volatile components were evaporated on the first day. After 8 days, about 50% of the oil remained. The report details the interaction between weather and loss of certain volatiles, and the effects of residual components on aquatic life.

[from Selected Water Resources Abstracts 9(16):#W76-08365. 1976]

C-0392-77
THE PHYSICAL BEHAVIOR OF OIL IN SANDY BEACHES, MCNABS ISLAND, NOVA SCOTIA
vonBorstal, D. E. 1974.
Master's thesis, Dalhousie University, Halifax, Nova Scotia.

Fate, Oil spills, Behavior, Beaches, Sediments, Canada, *Nova Scotia

Summary not available.

[from Bibliography and Index of Geology 40(10):1620. 1976]

3. CHEMICAL CHANGES OF OIL

C-0393-77
SOME MECHANISMS OF WEATHERING OF PETROLEUM HYDROCARBONS ON MARINE WATERS: COMPETITIVE PATHWAYS TO FATE AND DISPOSITION OF PETROLEUM POLLUTION
Feldman, M. H. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.431-450.

Fate, Hydrocarbons, Oil slicks, Weathering, Sedimentation

The character of petroleum hydrocarbons which are spread on the sea is changed through weathering mechanisms such as photolysis, trace material interactions on the surface layers, and sedimentation processes.

[from Selected Water Resources Abstracts 9(20):#W76-11010. 1976]

C-0394-77
THE SURFACE ACTIVITY OF PETROLEUM AND ITS INFLUENCE ON THE BEHAVIOR OF OIL AT SEA
Garrett, W. P. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.451-461.

Oil slicks, Behavior, Weathering, Spreading, Evaporation, Tar

A greater exposure to air and underlying water is produced by the polaractive constituents of petroleum which cause the oil to spread, thereby enhancing the weathering process by increasing the surface to volume ratio of the oil. Modifications of fluid petroleum to form non-fluid or semi-fluid residues are primarily due to spreading and evaporative processes.

[from Selected Water Resources Abstracts 9(20):#W76-11011. 1976]

4. GENERAL FATE OF OIL

C-0395-77
TRANSPORT MODELING IN THE ENVIRONMENT USING THE DISCRETE-PARCEL-RANDOM-WALK APPROACH
Ahlstrom, S. W., and H. P. Foote. 1976.
EPA Conference on Environmental Modeling and Simulation. p.118. Abstract.

Models, Fate, Drift, Oil spills, *Discrete-parcel-random-walk model

An explanation of the Discrete-Parcel-Random-Walk model is given; and examples of the model's application in the areas of oil spill drift forecasting, coastal power plant effluent analysis, and solute transport in groundwater systems are presented.

[from Pollution Abstracts 7(5):#76-05002. 1976]

C-0396-77
CONCENTRATIONS AND DISTRIBUTION OF OIL POLLUTANTS IN MCNABS COVE, HALIFAX HARBOUR, NOVA SCOTIA
Brisco, C. D. 1974.
Maritime Sediments 10(2):67.

Distribution, Contaminants, Beaches, Sediments, Canada, *Nova Scotia, *Halifax Harbour

A study of the distribution of oil in a nearshore marine environment subject to chronic oil pollution has shown that beached oil is continually winnowed from the beaches and becomes most concentrated in nearshore sands in the form of agglutinated oil and silt particles and oil-coated organic matter. In silty and muddy offshore areas, oil is more evenly distributed and occurs mostly as tar fragments.

C-0397-77
DISTRIBUTION OF HYDROCARBONS IN A SALT MARSH ECOSYSTEM AFTER AN OIL SPILL AND PHYSIOLOGICAL CHANGES IN MARSH ANIMALS FROM THE POLLUTED ENVIRONMENT
Burns, K. A. 1975.
PhD thesis, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution.

Oil spills, Fate, Distribution, Hydrocarbons, *Salt marsh, Biological effects, *Marsh animals

Summary not available.

C-0398-77
BIOLOGICAL FATE OF PETROLEUM HYDROCARBONS IN AQUATIC MACRO-ORGANISMS
Clark, R. C. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.485-506.

Fate, Hydrocarbons, Metabolism,Food web, Marine organisms, Microorganisms

Persistent low-level petroleum pollution in the marine environment will be difficult to assess until the metabolic fate of hydrocarbons in the food web and in aquatic microorganisms is examined. Observations of hydrocarbon uptake by marine organisms are discussed and characteristic differences between biogenic and petroleum hydrocarbons are presented.

[from Selected Water Resources Abstracts 9(20):W76-11014. 1976]

C-0399-77
OIL POLLUTION ALONG GUJARAT COAST AND ITS POSSIBLE SOURCE
Dwivedi, S. N., B. N. Desai, A. H. Parulekar, V. Josanto, and M. D. George. 1974.
Mahasagar 7(1-2):91-94.

Crude oil, Fate, Chemical analysis, Chromatography, Beaches, Coasts, India, *Tar balls

Tar ball deposition on the beaches of Gujarat and pollution by oil derivatives along the Indian coastline are discussed. The origin of tar balls has been traced to crude oil through studies using thin layer chromatography.

[from Aquatic Sciences and Fisheries Abstracts 6(10):#6Q11045. 1976]

C-0400-77
A STUDY OF NATURAL OIL SEEPS IN SOUTHERN CALIFORNIA/COASTAL ENGINEERING
Fischer, P. J., and B. R. Warren. 1974.
University of Southern California. Technical report, NOAA-75062401; NTIS-COM-75-10999/AS. 61p.

Natural seepage, Southern California, *Coal Oil Point, *Geologic history

The geologic history of natural oil seeps at Coal Oil Point and Newport - Huntington Beaches, California is reviewed.

[from Sea Grant Publications Index 1975 1:#5CU-Q-74-001. 1976]

C-0401-77
MARINE POLLUTION
Goldberg, E. D., and K. K. Bertine. 1975.
Environment. W. W. Murdoch (ed.). Sunderland, Mass., Sinauer Associates, Inc., 1975. p.273-296.

Movement, Fate, Hydrocarbons, Biodegradation, Marine organisms, *Chemoreception

The major sources, movement, dispersion and ultimate fate of pollutants in the marine environment are considered in this chapter. The fate of specific pollutant groups including heavy metals, pecticides, organic compounds, and petroleum hydrocarbons is summarized. It is noted that in the case of petroleum, the assumption that it is entirely biodegradable in a fairly short time span may not be valid. The need for further studies on the interference of petroleum hydrocarbons with processes of chemoreception in marine organisms is pointed out.

C-0402-77
A WIND WAVE TUNNEL FOR THE INVESTIGATION OF ARTIFICIAL SLICK WAVE DAMPING AND DRIFT
Hühnerfuss, H., P. Lange, J. Teichert, and H. Vollmers. 1976.
Meerestechnik 7(1):23-26.

Oil slicks, Fate, Drift, *Wind-wave tunnel, *Wave damping

"The SFB94 wind tunnel has been designed for investigating air-sea interaction processes. Waves ranging from 0.6 to over 100 Hz in frequency and 0.1 to 8 cm in height can be produced and measured in the tunnel. A special air filter system and film removing apparatus allow reproducible experiments involving oil film wave damping and drift.

C-0403-77
CHEMICAL COMPOSITION: A CONTROL ON THE PHYSICAL AND CHEMICAL PROCESSES ACTING ON PETROLEUM IN THE MARINE ENVIRONMENT
Koons, C. B. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia. 1973. Vol. 2. p.475-484.

Fate, Crude oil, Oceans, Evaporation, Weathering, Biodegradation

The physical and chemical processes that transform petroleum are dependent upon the chemical composition of petroleum released into the marine environment by spills, natural seepages, and chronic low-level discharges. Evaporation, solution, and absorption are most important during the period immediately following the release of oil into the environment; whereas autooxidation and microbial degradation are long-range processes that become increasingly important as time passes. Weathering of petroleum leads to tar ball formation. Analytical chemical studies of tar balls provide information on the source, degree of weathering, and relative importance of different weathering processes.

[from Selected Water Resources Abstracts 9(20):#W76-11013. 1976]

C-0404-77
FATES OF PETROLEUM IN THE SEA: BIOLOGICAL ASPECTS
Lee, R. F., and A. A. Benson. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.541-551.

Fate, Metabolism, Hydrocarbons, Phytoplankton, Zooplankton, Fishes, Invertebrates

The uptake, metabolism, discharge, and storage of hydrocarbons in selected species of phytoplankton, zooplankton, fish and benthic invertebrates have been studied using seawater suspensions and solutions of radioactive hydrocarbons. This report will summarize the results of the studies and present a discussion on the fate of dissolved and dispersed petroleum in the sea.

[from Selected Water Resources Abstracts 9(20):#W76-11017. 1976]

C-0405-77
ESTUARINE OIL DISPERSION MODEL
Mattis, W. E. 1975.
Model Simulation Conference, 6th, Pittsburgh, Pennsylvania, 1975. 6(2):873-875.

Models, Oil discharges, Fate, Estuaries

Two models are derived that can be used to determine the propagation and concentration of oil in an estuary due to an accidental discharge from a ship or port unloading facility.

[from The Engineering Index Monthly 14(10):#071237. 1976]

C-0406-77
HYDROCARBON DISPERSION IN GROUND WATER; SIGNIFICANCE AND CHARACTERISTICS
Osgood, J. O. 1974.
National Ground Water Quality Symposium, 1974. No. 2:99-110.

Oil spills, Hydrocarbons, Fate, Dispersions, Groundwater

The effects of hydrocarbon spills on groundwater systems can be significant. The hydrogeologic characteristics at the drill site determine whether spilled hydrocarbons reaching the water table will flow with the groundwater flow system or diverge from it.

C-0407-77
PROCEEDINGS OF THE NATIONAL GROUND WATER QUALITY SYMPOSIUM (2ND), HELD AT DENVER, COLORADO, ON SEPTEMBER 25-27, 1974.
National Water Well Association. 1974.
Contract EPA-68-03-0367. 254p.

Hydrocarbons, Groundwater, Water quality, Dispersions

This conference covered all facets of ground water quality including hydrocarbon dispersion in ground water.

[from Government Reports Announcements 76(23):#PB 257 312/9GA. 1976]

C-0408-77
EVALUATION OF SEISMICITY AND EARTHQUAKE SHAKING AT OFFSHORE SITES
Page, R. A. 1975.
Offshore Technology Conference, 7th, Houston, Texas, 1975. Vol. III. No. OTC 2354. p.179-190. Preprint.

Offshore development, Fate, Contamination, Gulf of Alaska, *Seismicity, *Ground shaking

Various methods and techniques used to evaluate seismicity and ground shaking at offshore sites are discussed. The Gulf of Alaska is used as an example in studying the effects of tsunamis, faulting, ground failure, submarine slides, and turbidity currents on possible oil pollution.

[from Selected Water Resources Abstracts 9(17):#W76-09379. 1976]

C-0409-77
ON THE POLLUTION OF NATURAL ENVIRONMENT BY OIL [English summary]
Riabchikov, A. M. 1974.
Moskovskiy Universitet, Vestnik, Seriya Geologii 29(2):11-19.

Fate, Crude oil, Decomposition, Arctic, Biological effects, Environmental effects

About 2% of the 2.5 billion tons of crude oil produced annually is lost during extraction, transport, processing and use. Whereas oil degrades rapidly in warm climates, crude oil in arctic climates (especially its heavy fractions) are preserved for months to years with chronic effects on entire ecosystems. Oil losses for 1985 are calculated to be nearly double the present levels unless preventive measures are undertaken.

C-0410-77
HEXADECANE DECOMPOSITION IN THE EUTROPHIED BAY OF SHIMODA AT SUMMER STAGNATION PERIOD
Seki, H. 1974.
Umi 12(4):186-191.

Decomposition, Hydrocarbons, Japan, *Hexadecane, *Shimoda Bay

The rate of hexdecane decomposition in Shimoda Bay was one order of magnitude lower than that of Tokyo Bay during the 1974 summer stagnation period. The decomposition activity was 80-89 m μg/l hr in the surface layer, lower in deeper layers, and 10 m μg/l hr in the Kurohio countercurrent outside the bay.

[from Chemical Abstracts 85(12):#82989w. 1976]

C-0411-77
THERMAL STRESS FOR HEXADECANE DECOMPOSITION IN SEAWATER OF A NATURAL ENVIRONMENT
Seki, H. 1975.
Umi 13(2):53-57.

Decomposition, Hydrocarbons, *Hexadecane, Seawater, Japan

"Microbial activity and hexadecare decomposition in salt water of thermal spring was studied, showing a linear relation between the logarithm of the in situ potentiality of hexadecane decomposition, mμg hexadecane/l seawater/hr, and temperature."

[from Chemical Abstracts 85(12):#82988v. 1976]

C-0412-77
OPERATIONAL MODEL FOR PREDICTING THE MOVEMENT OF OIL IN CANADIAN NAVIGABLE WATERS
Simons, T. J., G. S. Beal, K. Beal, E. Shaarawi, and T. S. Murphy. 1975.
Marine Sciences Directorate Manuscript Report Series No. 37. 30p.

Oil slicks, Movement, Models, St Lawrence River, Canada

The feasibility of an operational model to simulate the movement of oil slicks in Canadian navigable waters is demonstrated. Details of the computer program and the data bank are included, and a hypothetical oil spill scenario in the St. Lawrence estuary is developed.

[from Selected Water Resources Abstracts 9(18):#W76-09908. 1976]

C-0413-77
POLYNUCLEAR AROMATIC HYDROCARBON POLLUTION OF THE MARINE ENVIRONMENT
Suess, M. J. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.801-808.

Hydrocarbons, PAH, Oceans, Source identification, Plants, Oil spills, Fate

All marine waters contain some level of polynuclear aromatic hydrocarbons (PAH) due to their production by aqueous flora. Further pollution occurs from municipal and industrial effluents, atmospheric precipitation and fallout, runoff, and oil spills. The presence and transmission of the PAH, 3,4-benzpyrene, through environmental waters and past studies of the factors affecting its stability are discussed.

[from Selected Water Resources Abstracts 9(20):#W76-11030. 1976]

C-0414-77
REENTRY OF 5-YEAR-OLD STRANDED BUNKER C FUEL OIL FROM A LOW-ENERGY BEACH INTO THE WATER, SEDIMENTS, AND BIOTA OF CHEDABUCTO BAY, NOVA SCOTIA
Vandermeulen, J. H., and D. C. Gordon, Jr. 1976.
Journal of the Fisheries Research Board of Canada 33(9):2002-2010.

Fate, Fuel oil, Chedabucto Bay, Canada, Beaches, Sediments, *Water column, Marine organisms, Chronic effects

Large amounts of Bunker C fuel oil remaining from the grounding of the Liberian Tanker Arrow five years ago is slowly being released to the littoral and sublittoral environments. Only trace amounts enter the water column directly. A parallel distribution to the low tidal and high interstitial oil distribution is found in tissue-bound oil in beach biota. Beach sediments appear to act as a natural sink, sequestering interstitial oil. Flow experiments indicate stranded oil will remain in excess of 150 years.

C-0415-77
FATE OF SPILLED OILS
Weiss, F. T. 1975.
Marine Environmental Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast, 1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p.185-197. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Fate, Oil spills, Oceans, Bibliographies, *Physical changes, *Chemical changes

Physical and chemical forces acting on spilled oil and the biochemical fate of oil are reviewed. A bibliography of 50 references is included.

[from Chemical Abstracts 85(16):#112 319x. 1976]

C-0416-77
THE TRANSPORT OF HYDROCARBONS BY THE PARTICULATE MATERIAL IN THE SEA
Zsolnay, A. 1975.
Marine Environmuntal Implications of Offshore Oil and Gas Development in the Baltimore Canyon Region of the Mid-Atlantic Coast,1974. L. E. Cronin (chairperson). Wachapreague, Virginia, Estuarine Research Federation, 1975. p.165-170. Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop.

Adsorption, Hydrocarbons, Offshore drilling, Oil transport, *Particulate matter

Recent field work confirms laboratory studies which have shown that particulate matter in the sea adsorbs petroleum hydrocarbons. By this mechanism, petroleum hydrocarbons produced by offshore drilling can be transported to deeper ocean areas.

[from Chemical Abstracts 85(18):#130229x. 1976]

F. OIL POLLUTION REGULATIONS

1. STATE LEGISLATION

C-0417-77
DEEPWATER PORT DEVELOPMENT IN NORTH CAROLINA: THE LEGAL CONTEXT
Dawson, A. C., III. 1976.
Critical Reviews in Environmental Control 6(2):157-184.

Legislation, State governments, Environmental protection, Offshore development, Ports, Oil transport, North Carolina

The existing laws which apply to the planning and establishment of deepwater or offshore ports are evaluated. The problem of balancing the forces of energy development against the forces of ecological conservation is discussed. Necessary interactions between state and federal laws concerning offshore development are pointed out by the study.

C-0418-77
THE ROLE OF NORTH CAROLINA IN REGULATING OFFSHORE PETROLEUM DEVELOPMENT
Kilpatrick, J. E. 1976.
Critical Reviews in Environmental Control 6(2):185-197.

Offshore development, Legislation, International agreements, U.S. government, State governments, North Carolina

The legal framework - international, federal, and state - for regulating offshore petroleum development is detailed. The historical conflict between federal and state governments over control of the seabed further than three miles from shore is reviewed. The pertinent federal legislation and North Carolina legislation are analyzed.

2. U.S. LEGISLATION

C-0419-77
COMPREHENSIVE OIL POLLUTION LIABILITY AND COMPENSATION ACT OF 1975
Anon. 1975
U.S. Code Congress and Administrative News. p.1512.

Legislation, U.S., Liability, Oil spills, *Compensation

The title Act has been proposed as a means for establishing a comprehensive and uniform system of fixing liability and settling claims for oil pollution damages in U.S. waters and coastlines. The comprehensive legislation would replace a patchwork of overlapping and sometimes conflicting state and federal laws.

[from Selected Water Resources Abstracts 9(22):#W76-11982. 1976]

C-0420-77
THE CRIMINAL OIL DISCHARGE
Eaton, L. R. 1976.
Pollution Engineering 8(10):12.

Legislation, U.S., Oil discharges, Law enforcement, *FWPCA

A recent legal case involving the 1972 Amendments to the Federal Water Pollution Control Act (FWPCA) is briefly reviewed. In the case, both a civil action suit and criminal charges for permitting oil discharges to enter U.S. waters were brought against a landfill operator. The case indicates that the federal government is actively enforcing the provisions of the FWPCA.

C-0421-77
PRIVATE ACTIONS FOR DAMAGES RESULTING FROM OFFSHORE OIL POLLUTION
Gordon, M. M. 1975.
Columbia Journal of Environmental Law 2(1):140-194.

Oil spills, Liability, *Private damage suits, Legislation, U.S.

Private damage suits resulting from offshore oil spills and pollution in U.S. coastal areas are examined, and relevant common law and recent statutory developments at the state and international levels are discussed. Comprehensive federal legislation is believed to offer the most satisfactory accommodation of the conflicting interests of private claimants and producers and transporters of oil. Three hundred references are included.

[from Environment Abstracts 6(7/8):#76-05038. 1976]

C-0422-77
MANDATORY CANADIAN CRUDE OIL ALLOCATION REGULATIONS
U.S. Federal Energy Administration. 1976.
Final environmental impact statement, FEA/H-76/220, FES-76/1.
375p.

Regulations, U.S., Crude oil, *Resource allocations, Canada, EIS, Economic effects, *FEA

"On January 30, 1976, the Federal Energy Administration (FEA) promulgated regulations to allocate diminishing amounts of Canadian crude oil deliveries during the period of 1976 through 1981." These regulations reflect FEA's activities to minimize the impact of the Canadian action.

[from Government Reports Announcements 76(21):#PB-255 319/6GA, 1976]

C-0423-77
STRATEGIC PETROLEUM RESERVE
U.S. Federal Energy Administration. 1976.
Draft environmental impact statement, FEA/G-76/331. 323p.

Legislation, U.S., Storage, Crude oil, Oil tanks, EIS, Environmental effects

FEA has identified three alternative storage systems for satisfying the objectives of the Strategic Petroleum Reserve program which was established by the Energy Policy and Conservation Act, 1975. These alternatives are discussed in this EIS. Prototype worst case facilities were developed to provide a basis for determining potential program impacts and resource requirements.

[from Government Reports Announcements 76(21):#PB-255 476/4GA, 1976]

3. INTERNATIONAL LEGISLATION

C-0424-77
THE FREEDOM OF NAVIGATION AND THE PROBLEM OF POLLUTION OF THE MARINE ENVIRONMENT
Kiselev, V. A. 1976.
Georgia Journal of International and Comparative Law Vol 6: 93-106.

Pollution prevention, Ships, Design and engineering, Regulations, Law enforcement, *International law

The article proposes internationally uniform ship construction and equipment standards, and unified international legislation for enforcing oil pollution regulations. It is also recommended that coastal states be provided with some rights for combatting oil pollution within a zone of the high seas adjoining their territorial waters.

[from Selected Water Resources Abstracts 9(22):#W76-12010, 1976]

C-0425-77
RESPONSIBILITY AND LIABILITY FOR HARM TO THE MARINE ENVIRONMENT
Stein, R. E. 1976.
Georgia Journal of International and Comparative Law 6:41-57.

Legislation, Environmental protection, Pollution prevention, Liability

Existing legislation for preventing or mitigating harm to the marine environment caused by pollution, including oil pollution, is reviewed and recommendations for new legal measures are presented.

[from Selected Water Resources Abstracts 9(22):#W76-12012, 1976]

4. FOREIGN LEGISLATION

C-0426-77
MARINE OIL POLLUTION LEGISLATION - WESTERN EUROPE
Brackley, P. G., and C. T. Savin. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 17p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

Legislation, Europe, International agreements, Pollution prevention, Oceans, Offshore production, Oil discharges, Cleanup

International conventions and European legislation relating to marine oil pollution are reviewed. Oil pollution from shipping, offshore exploration and production, land-based sources, and from dumping at sea is discussed. The need for regional and international cooperatives in spill prevention and cleanup is stressed.

5. AGREEMENTS AND CONVENTIONS

C-0427-77
INTERNATIONAL COOPERATION FOR THE PREVENTION OF MARINE OIL POLLUTION. OCEAN AND OCEAN LAW PROGRAM
Anderson, A. W., and W. K. Bissell. 1975.
Sea Grant Technical Bulletin 33, NOAA-76041404; Contract NOAA-04-5-158-14. 154p.

Pollution prevention, International conventions, Oil spills, Oil discharges

In this paper initial definitions are provided concerning the marine ecosystem, oil, and the interaction of these two; and the general history of international cooperation and international awareness and agreements relating to marine oil pollution are discussed. This writing details the most recent developments leading up to the 1976 New York Law of the Sea Conference.

[from Government Reports Announcements 76(17):#PB-253 970/8GA. 1976]

C-0428-77
MARINE LAW: IMCO'S PROGRAMME OF ACTION ON OIL POLLUTION
Anon. 1975.
Shipping World and Shipbuilders 168(3909):889.

International conventions, Oil spills, Liability, Tankers, Ships, Insurance

Among the objectives of the International Convention on Civil Liability for Oil Pollution Damage are the assurance of adequate compensation for persons suffering damage from oil spills, and the placement of liability for spill damages on the owner of the ship from which the pollutant oil escaped. Oil carrying vessels with capacities greater than 2000 tons of crude oil are required to maintain adequate insurance to cover oil spill damages.

[from Oceanic Abstracts 13(5):76-04991. 1976]

C-0429-77
MARINE POLLUTION: MEDITERRANEAN
Anon. 1976.
Bulletin of Legal Developments No 4:39. Summary.

International conventions, Pollution prevention, Oil discharges, Mediterranean Sea

A UN-sponsored conference dealing with oil pollution in the Mediterranean Sea was held in Barcelona, Spain in February, 1976.

Twelve of the eighteen countries represented signed a framework convention containing protocols regarding the dumping of wastes and cooperation in combatting oil pollution.

[from Oceanic Abstracts 13(5):#W76-04973. 1976]

C-0430-77
IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN JOINT GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS OF MARINE POLLUTION (GESAMP). REPORT OF THE EIGHTH SESSION
Food and Agriculture Organization. 1976.
Rome, Food and Agriculture Organization, 1976. 12p. (GESAMP Reports and Studies No. 4.)

International conventions, Oil spills, Contamination, Environmental effects, Oceans, *GESAMP

This report covers the agenda of the 4th GESAMP meeting which was held at FAO Headquarters in Rome, April 21-27, 1976. Actions taken on the topics under discussion at the meeting are summarized. Topics included a review and evaluation of the hazards of harmful substances in the marine environment, impact of oil on the marine environment, and the interchange of pollutants between the atmosphere and oceans.

C-0431-77
MARINE POLLUTION - LEGAL AND FINANCIAL ASPECTS
Holmes, P. R. 1976.
Prevention and Control of Marine Oil Pollution, Brisbane, Australia, 1976. North Sydney, Australia, Petroleum Institute Environmental Conservation Executive, 1976. 18p. Regional Marine Oil Pollution Conference - Australia. Technical Papers.

International agreements, International conventions, Pollution prevention, Ships, Legislation, Liability, Economics

The role of international agreements in mitigating or preventing marine oil pollution by ships is examined and found to be of major significance for initiating controls; determining rights, powers, and obligations; and in providing compensation for oil pollution damages. Existing and proposed international conventions dealing with preventive measures, providing for legal intervention by coastal states, and assessing liability and damage compensation are briefly reviewed. Recommendations for filling legal gaps on the national and international levels are outlined.

C-0432-77
LIABILITY FOR MARINE ENVIRONMENT POLLUTION DAMAGE IN CONTEMPORARY INTERNATIONAL SEA LAW
Makovsky, A. L. 1976.
Georgia Journal of International and Comparative Law 6:59-71.

International conventions, Liability, Oil spills, Legislation, *UN Law of the Sea

Various international conventions dealing with liability for damage to the marine environment are examined, including conventions dealing with oil pollution. The legal bases for these conventions and liability principles of the proposed UN Law of the Sea are explored.

[from Selected Water Resources Abstracts 9(22):#W76-12011. 1976]

C-0433-77
DIE BEDEUTUNG DER KONVENTION ZUM SCHUTZE DER OSTSEE FUER SCHLESWIG-HOLSTEIN (IMPLICATIONS OF THE CONVENTION FOR THE PROTECTION OF THE BALTIC SEA FOR SCHLESWIG-HOLSTEIN). [English summary]
Petersen, M. 1975.
Deutsche Gewaesserkundliche Mitteilungen 19(Sonderheft):27-29.

International conventions, Pollution prevention, Environmental protection, Baltic Sea, Oil discharges, Ships

The following obligations were taken by all seven riparian countries meeting at the 1974 convention: measures to prevent pollution from land sources and ships, development of standard criteria for pollution control, joint action in preventing large scale marine pollution, and complementation of the Oslo and London anti-dumping conventions by a more stringent prohibition of waste dumping. Joint Danish-German proposals for water quality control in Schleswig-Holstein coastal waters have been formulated and are discussed.

[from Pollution Abstracts 7(5):#75-04374. 1976]

6. STANDARDS AND GUIDELINES

C-0434-77
COMPENSATION FOR OIL POLLUTION AT SEA: AN INSURANCE APPROACH
Goria, C. F. 1975.
Federation of Insurance Counsel Quarterly 26:3-26.

Oil spills, Insurance, Liability, International conventions, Legislation, Economics

An examination of present liability standards shows that monetary damages from oil spill accidents are distributed inequitably, and the national approaches to oil pollution insurance are inadequate because of extreme limitations of liability. Recent international conventions and agreements do not yet protect claims adequately. Recommendations are made regarding private claims and more equitable loss distribution between the shipping industry, oil companies and consumers. An extensive bibliography is included.

[from Selected Water Resources Abstracts 9(22):#W76-11975. 1976]

C-0435-77
MANUAL ON OIL POLLUTION
IMCO. n.d.
London, Inter-Governmental Maritime Consultative Organization Publications Section. 73p.

Manuals, Oil spills, Pollution prevention, Containment, Cleanup, Guidelines

The manual provides practical information on means of dealing with oil spillages.

[from IMCO Publications Catalogue. July, 1976. p.5]

C-0436-77
DEVELOPMENT DOCUMENT FOR INTERIM FINAL EFFLUENT LIMITATIONS GUIDELINES AND NEW SOURCE PERFORMANCE STANDARDS FOR THE OFFSHORE SEGMENT OF THE OIL AND GAS EXTRACTION POINT SOURCE CATEGORY
U.S. Environmental Protection Agency. 1975.
Special report, EPA 440/1-75/005 Group II. 159p.

Wastewater treatment, Guidelines, Regulations, Offshore drilling, Offshore production

Effluent limitations, guidelines, performance standards, and pretreatment standards for the offshore oil and gas extraction industry are discussed. Data are presented on characteristics of production, drilling, and sanitary and domestic wastes including oily wastes. Waste treatment and control technology alternatives are reviewed with emphasis on best available technologies.

[from Environment Abstracts 6(7/8):#76-05074. 1976]

C-0437-77
OFFSHORE SEGMENTS OF THE OIL AND GAS EXTRACTION POINT SOURCE CATEGORY

U.S. Environmental Protection Agency. 1975.
Federal Register 40(179):42572-42577.

Regulations, Guidelines, Offshore production, Oil discharges, Pollution control, *EPA

EPA is publishing regulations which provide effluent limitations guidelines and pretreatment standards for existing and new offshore oil and gas production facilities. The quantity and quality of pollutants which may be discharged by point sources subject to regulation are tabulated according to point source category.

[from Selected Water Resources Abstracts 9(22):#W76-11994. 1976]

G. BIBLIOGRAPHIES

C-0438-77
BASELINE STUDY PROGRAM. NORTH PUGET SOUND. BIOLOGICAL OIL IMPACT LITERATURE REVIEW. VOLUME II. BIBLIOGRAPHY
Buell, J. W., and V. W. Kaczynski. 1975.
Final report, WA/DOE/BA-75/02. 467p.

Bibliographies, Biological effects, Oil spills, Petrochemicals, Marine organisms, Puget Sound

This annotated bibliography covers current available literature on the ecology of the significant biological resources of Puget Sound and on the effects of oil spills and petrochemicals on those biota. Certain references of general interest on the subject of oil pollution and marine organisms are included. (See also Volume 1, Text; C-0272-77, p.106).

[from Government Reports Announcements 76(19):#PB-254 292. 1976]

C-0439-77
WASTE PROCESSING AND POLLUTION IN THE CHEMICAL AND PETROCHEMICAL INDUSTRIES. VOLUME 2. (A BIBLIOGRAPHY WITH ABSTRACTS)
Cavagnaro, D. M. 1976.
NTIS report for 1975 - June 1976. 164p.

Bibliographies, Wastewater treatment, Industries, Petrochemicals, Economics, *Industrial wastes, *Pollution effects

This updated bibliography contains 159 abstracts (23 of which are new entries to the previous edition) on studies of air and water pollution and solid wastes for the chemical and petrochemical industries. Control processes, emissions, economics, pollution effects, and abatement strategies are covered.

[from Government Reports Announcements 76(19):NTIS/PS-76/0607/20A. 1976]

C-0440-77
BIBLIOGRAPHY ON OIL RIG INSURANCE
Chartered Insurance Institute. 1975.
London, The Chartered Insurance Institute, 1975. 3p.

Bibliographies, Offshore drilling, Insurance, Liability, *Oil rig insurance

Among the topics covered by this bibliography are: marine insurance, offshore drilling, accident prevention, pollution liability, and contractor's and employer liability.

[from Offshore Abstracts 3(3):#76-1743. 1976]

C-0441-77
SOURCES OF INFORMATION IN WATER RESOURCES - AN ANNOTATED GUIDE TO PRINTED MATERIALS
Giefer, G. J. (ed.). 1976.
New York, Water Information Center, Inc. 1976. 290p.

Bibliographies, Oil spills, Environmental effects

This bibliography with abstracts covers many facets of water resources including oil pollution, oil spills, and the effect of such pollution on the environment.

C-0442-77
OFFSHORE DRILLING (A BIBLIOGRAPHY WITH ABSTRACTS)
Habercom, G. E., Jr. 1976.
NTIS report for 1964 - July, 1976. 156p.

Bibliographies, Offshore drilling, Oil wells, Environmental effects

This bibliography contains 154 abstracts (38 of which are new entries to the previous edition) covering the following topics: drilling procedures, equipment, environmental aspects, and legal implications involved in oceanic mineral resources recovery.

[from Government Reports Announcements 76(20):#NTIS/PS-76/0627/0GA. 1976]

C-0443-77
SUPERTANKERS AND SUPERPORTS (CITATIONS FROM THE ENGINEERING INDEX DATA BASE)
Habercom, G. E. 1976.
NTIS report for 1970 - June, 1976. 82p.

Bibliographies, Tankers, Ports, Environmental effects, *Supertankers,*Deepwater ports

This bibliography includes 75 abstracts covering construction and operation of supertankers and requirements for port facilities. Environmental aspects, offshore mooring sites, and harbor preparation are among the topics investigated.

[from Government Reports Announcements 76(19):#NTIS/PS-76/0592/6GA. 1976]

C-0444-77
SUPERTANKERS AND SUPERPORTS (CITATIONS FROM THE NTIS DATA BASE)
Habercom, G. E. 1976.
NTIS report for 1964 - June, 1976. 102p.

Bibliographies, Tankers, Ports, Environmental effects, *Supertankers, *Deepwater ports

Ninety-seven abstracts are contained in this report reviewing construction and operation of supertankers, requirements for port facilities, and environmental aspects.

[from Government Reports Announcements 76(19):#NTIS/PS-76/0591/0GA. 1976]

C-0445-77
A LITERATURE REVIEW OF THE BIOLOGICAL IMPACT OF OIL SPILLS IN MARINE WATERS
Mertens, E. W. 1973.
Background Papers for a Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment, Airlie, Virginia, 1973. Vol. 2. p.744-767.

Bibliographies, Oil spills, Biological effects, Environmental effects, Toxicity, Marine organisms

Selected literature is reviewed on the biological impact of oil on the marine environment. Emphasis is placed on the environmental effects of oil spills and on bioassays to determine the toxicity of oils to marine organisms.

[from Selected Water Resources Abstracts 9(20):#W76-11027. 1976]

C-0446-77
THE BIOLOGICAL AND ECOLOGICAL EFFECTS OF OIL POLLUTION IN TROPICAL WATERS. AN ANNOTATED BIBLIOGRAPHY
Onuf, C. P. 1973.
Agency for International Development, Department of State, Report AID/csd 2602. PB-248 899. 67p.

Bibliographies, Biological effects, Environmental effects, Contamination, Oil spills, Biodegradation, Marine organisms, *Tropical waters

The annotated bibliography contains 112 references to the biological and ecological effects of oil pollution in tropical waters; some references to effects in colder, higher latitude waters are also included.

[from Selected Water Resources Abstracts 9(22):#W76-11936. 1976]

C-0447-77
OIL SPILL REMOVAL TECHNIQUES AND EQUIPMENT (A BIBLIOGRAPHY WITH ABSTRACTS)
Smith, M. F. 1976.
NTIS report for 1965 - June, 1976. 252p.

Bibliographies, Oil spills, Cleanup, Recovery, Oil-water separation, Skimmers, Adsorption, Dispersants, Flotation

Techniques cover oil-water separation, skimming, dispersion, adsorption, flotation, and combustion. Oil spreading, droplet entrainment, prototype removal sytems, equipment, and costs are also reviewed. The bibliography contains 247 abstracts, 46 of which are new entries to the previous edition.

[from Government Reports Announcements 76(20):#NTIS/PS-76/0637/9GA. 1976]

C-0448-77
WASTE PROCESSING AND POLLUTION IN THE CHEMICAL AND PETROCHEMICAL INDUSTRIES. VOLUME 1. 1964-1974 (A BIBLIOGRAPHY WITH ABSTRACTS)
Werner, R. G., and D. M. Cavagnaro. 1976.
NTIS report for 1964-1974. 181p.

Bibliographies, Wastewater treatment, Industries, Petrochemicals, Economics, *Industrial wastes, *Pollution effects

This updated bibliography contains 176 abstracts on air and water pollution and solid wastes for the chemical and petrochemical industries. Control processes, emissions, economics, and abatement strategies are covered.

[from Government Reports Announcements 76(19):#NTIS/PS-76/0606/4GA. 1976]

SECTION II: CURRENT RESEARCH PROJECTS

Title, contract information and a summary of project objectives are provided in each entry. Project notices have been obtained from the Smithsonian Science Information Exchange (SSIE); American Society for Microbiology, Aquatic Microbiology Newsletter; and Canada, Department of the Environment, Spill Technology Newsletter. Current status information and publications resulting from the projects are presented when such information is available from the principal investigators or performing organizations. The source of status information is given at the end of each entry.

Entries are grouped according to subject and then ordered by serial number within each subject division. The serial number designates the original issue of OIL SPILL AND OIL POLLUTION REPORTS in which the research project is listed:

R-001-74 to R-165-74	EPA-670/2-75-003 July 74 to October 74
R-166-74 to R-244-74	EPA-670/2-75-044 November 74 to February 75
R-245-74 to R-268-74	EPA-670/2-75-059 February 75 to April 75
R-269-74 to R-342-74	EPA-600/2-76-129 May 75 to July 75
R-269-75 to R-304-75	EPA-600/2-76-113 August 75 to October 75
R-001-76 to R-035-76	EPA-600/2-76-185 November 75 to January 76
R-064-76 to R-123-76	May 76 to July 76
R-124-76 to R-175-76	August 76 to October 76
R-001-77 to R-022-77	November 76 to January 77

A. OIL POLLUTION DETECTION AND EVALUATION

1. MONITORING

R-282-74 (renewal)
MONITORING HYDROCARBONS ON AND IN SEA WATER
Principal Investigator: Brown, C. W.
Performing Organization: University of Rhode Island, School of Arts & Sciences, Woodward, Kingston, RI 02881
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sea Grant Office
Period: 7/75 to 6/76
Funds: $16,596

Immediate objectives are to determine seasonal variations in surface films and dissolved organics in seawater, pleasure craft and commercial harbors, and in the open sea; to determine those components of petroleum that dissolve sea water or are otherwise removed during weathering; and to explore new methods for identifying the source of petroleum on sea water. The types and relative amounts of hydrocarbons have been determined for the following: beach sands from nine locations along the Rhode Island coast, over 60 samples of surface and subsurface water from a pleasure craft harbor, surface samples from a commercial fishing harbor and Narragansett Bay. A new method for fingerprinting petroleum has been developed and separation of hydrocarbon components in weathered and unweathered petroleum samples has been initiated.

[SSIE No. GBP-1573-1]

R-002-76 (renewal)
HYDROCARBON STUDIES IN PUGET SOUND AND OFF THE WASHINGTON COAST
Principal Investigator: Carpenter, R. , and A. W. Fairhill
Performing Organization: University of Washington, Department of Oceanography, Seattle, WA 98195
Supporting Agency: U.S. Energy Research and Development Administration, Biomedical and Environmental Research Division, No. BER-76-393, Contract E(45-1)-2225 TA40.
Period: 6/76 to 5/77
Funds: $170,000

Seasonal samplings of phytoplankton, zooplankton and neuston are being made within Puget Sound and off the west coast of Washington. Hydrocarbons are being removed from these samples and characterized for the purpose of establishing the natural distribution of hydrocarbons in local marine organisms and to determine the extent to which organisms may be contaminated by petroleum hydrocarbons from oil spills. Cores of sediment are also being collected and analyzed and sediment accumulation rates determined so as to determine profiles of changes in hydrocarbon types and amounts during the past 100 years.

[SSIE No. GPE-5809]

R-125-76
BAY OF FUNDY STUDIES
Principal Investigator: Duerden, C.
Performing Organization: Environmental Protection Service
Atlantic Region, Halifax, Nova Scotia
B3J 3E4, Canada
Supporting Agency: Canada, Department of the Environment,
Environmental Protection Service
Period: Unknown

The Environmental Protection Service - Atlantic Region conducted a four-day survey of the Bay of Fundy shoreline in order to identify highly sensitive areas. The development of an environmental atlas for the Bay of Fundy is nearing completion. The project should be completed by December, 1976. Sea trials of slick-tracking devices are being prepared at Fundy. The high frequency of fog in the bay lends particular importance to the finding of such a device that will perform properly.

[J. R. MacDonald, Environmental Protection Service - Atlantic Region. Spill Technology Newsletter 1(4):41. July-August, 1976]

Status: The testing program of slick tracking devices was planned to begin in mid-December in conjunction with the Canada Center for Remote Sensing and the Canadian Coast Guard. If the preliminary results prove encouraging, the program will continue in the Bay of Fundy during the first week in February. No reports have been prepared at present.

Information Source: F. C. Duerden, Environmental Emergency
Branch, Environmental Protection Service
5151 George St., 17th floor, Halifax,
Nova Scotia B3J 1M5, Canada

3 OF 4

PB

268248

R-001-77

DEVELOPMENT OF A MARSH CONDITION INDEX

Principal Investigator: Dunstan, W.
Performing Organization: University of Georgia, Skidaway Institute of Oceanography, P.O. Box 13687, Savannah, GA 31406
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sea Grant Office
Period: 7/75 to 6/76
Funds: $8,500

The research aim is to find one or a set of physiological characteristics of Spartina which can be easily and quickly measured to yield a statistically valid "condition index". The condition index would be used to measure potential or actual effects on the marsh of oil and other industrial effluent spills, changes caused by increased nutrient levels, success of projects to rebuild salt marshes after roadbuilding, dredging or mining operations, and the laboratory assay of potential industrial effluents.

Status: Total non-structural carbohydrates have been measured over a year's cycle in three marshes. The results of this research have been submitted to Botania Marine for publication. The comparative production and relatud morphological changes in three marshes have been published in a Technical Report. Measurements of chlorophyll, iron, and nitrogen have been made over a year's cycle, and a report on this work is in preparation. Sampling of marsh areas in Florida, Georgia, and South Carolina has been initiated.

[SSIE No. GBP-2170]

R-002-77

SOUTHERN CALIFORNIA BORDERLAND - ENVIRONMENTAL

Principal Investigator: Greene, H. G.
Performing Organization: U.S. Department of the Interior, Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025
Supporting Agency: U.S. Department of the Interior, Geological Survey, Geologic Division, No. 9460-01650
Period: 7/75 to 6/76

A study is being conducted to identify, map, and report the geologic hazards and problems that exist in the southern California Borderland, specifically in areas where future development may take place. Geological hazards consist of faults, submarine landslides and slumps, hydrocarbon seeps, salt water intrusion sites, contaminant pathways, and areas of anomalous high erosion and sedimentation. Areas to be looked at include the central part of Santa Rosa-Cortes Ridge, San Diego shelf, western Santa Barbara Channel, and miscellaneous OCS areas that lie in water depths shallower than 750 m.

[SSIE No. ZUA-3979]

Reports and Publications

PRELIMINARY REPORT ON THE ENVIRONMENTAL GEOLOGY OF SELECTED AREAS OF THE SOUTHERN CALIFORNIA CONTINENTAL BORDERLAND
Green, H. G., S. H. Clarke, Jr., M. E. Field, F. I. Linker, and H. C. Wagner. 1975.
U.S. Department of the Interior, Geological Survey. Open-File Report 75-596. 70p.

Selected areas of the Southern California continental borderland have been studied to define the nature and extent of geologic hazards which could affect the environment as a result of the development of petroleum resources in this region. The areas designated for leasing in Federal Outer Continental Shelf lease sale 35 were studied in detail. The geologic phenomena investigated include faulting, seismicity, sediment instability, sediment erosion, and oil and gas seeps. Faulting and seismic activity are major hazards in all of the areas. Additional information is necessary for a complete evaluation of geologic hazards in the borderland region.

Information Source: H. G. Greene, U.S. Department of the Interior,
Geological Survey, 345 Middlefield Rd.,
Menlo Park, CA 94025

R-003-77

MODIFY THE OIL DETECTION BUOY SYSTEM AND PROVIDE LONGTERM FIELD EVALUATION

Principal Investigator: Gross, H. G.
Performing Organization: Spectrosystems Corporation, 3723 Ocean Crest, Santa Ana, CA 92704
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The purpose of the project is to yield an oil detection buoy system capable of operation in remote unattended areas deriving its power from a rechargeable battery pack with telemetering alarm and operational status conditions.

[SSIE No. GZ-58504]

Status: Three oil detection buoys are presently being prepared and will undergo lab and field tests in New Haven Harbor, Connecticut, during the month of January, 1977. After these tests, the buoys will be installed in the River Rouge in Detroit, Michigan, for the monitoring of oil levels in the river waters. The operational system to be established in the River Rouge is the first of its kind and will transmit oil detection signals to the U.S. Coast Guard station in Detroit. A new contract is being prepared for the maintenance of the detection system over a one year period.

Information Source: H. G. Gross, Spectrosystems, 3723 Ocean
Crest, Santa Ana, CA 92704

V. REMOTE SENSING

R-004-77

MULTISPECTRAL, REMOTE SENSING AS A FRESH WATER QUALITY SURVEILLANCE TOOL

Principal Investigator: Carritt, D. E.
Performing Organization: University of Massachusetts, Graduate School, Amherst, MA 01002
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology. No. A-084-MASS
Period: 1/76 to 9/77

The demonstration of remote, multispectral sensing as a unique tool for the study and surveillance of environmental properties in freshwater resources in Massachusetts is proposed. Remotely sensed multispectral data will be used to evaluate distribution of surface slick materials and other phenomena on land and in aquatic areas.

[SSIE No. GUY-475-1]

R-005-77

MAINTENANCE FOR THE AIRBORNE OIL SURVEILLANCE SYSTEM (AOSS)

Principal Investigator: Unknown
Performing Organization: Aerojet General Corporation, 9236 E. Hall Rd., Downey, CA 90241
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The contract provides for (1) advice and assistance in the operation and maintenance of the AOSS; (2) system and subsystem performance evaluation; (3) adjustment, alignment, test and checkout of the system; (4) troubleshooting and field repair.

[SSIE No. GZ-58334-1]

3. ANALYSIS

R-283-74 (renewal)
PETROLEUM CONTAMINATION - QUANTIFICATION AND PASSIVE TAGGING IN ORGANISMS
Principal Investigator: Farrington, J. W.
Performing Organization: Woods Hole Oceanographic Institution, Main St., Woods Hole, MA 02543
Supporting Agency: U.S. Environmental Protection Agency, Office of Research and Development
Period: 1/75 to 12/75
Funds: $70,043

Relatively simple, reliable, analytical methods were developed for routine use in the laboratory to quantify petroleum contamination at the 1 ppm (wet weight) level in marine organisms and aquatic sediments, and to correlate oil contamination of marine organisms and sediments with sources of contamination - "passive tagging".

[SSIE No. GMA-2568]

Reports and Publications

EVALUATION OF SOME METHODS OF ANALYSIS FOR PETROLEUM HYDROCARBONS IN MARINE ORGANISMS
Farrington, J. W., and G. C. Medeiros. 1975.
Conference on Prevention and Control of Oil Pollution, San Francisco, 1975. p.115-121.

The composition and concentration of hydrocarbons in clams from areas of different pollution levels were determined. After spiking a clam homogenate with 10 ppm API No. 2 fuel oil, only 5 to 6 ppm of the spike were detected. Hydrocarbons already in the clams interfered with the tagging parameters of the spike.

INTERCALIBRATION OF GAS CHROMATOGRAPHIC ANALYSES FOR HYDROCARBONS IN TISSUES AND EXTRACTS OF MARINE ORGANISMS
Farrington, J. W., J. M. Teal, G. C. Medeiros, K. A. Burns, E. A. Robinson, Jr., J. G. Quinn, and T. L. Wade. 1975.
Analytical Chemistry 48(12):1711-1716.

Analyses of petroleum hydrocarbons separated from tuna meal samples and cod liver lipid extracts were performed using gas chromatography. Measured values of hydrocarbons spiked to samples of cod liver oil are presented. Limitations to current methods of analysis used in this and other current studies are discussed.

PETROLEUM HYDROCARBONS

Farrington, J. W., J. M. Teal, and P. L. Parker. 1976.
Strategies for Marine Pollution Monitoring. E. D. Goldberg (ed.). New York, John Wiley & Sons, Inc., 1976. p.3-34.

In this chapter, the authors set forth principles for the analysis of marine samples for petroleum hydrocarbons with a boiling range above n-tetradecane. Continuing research needs in the measurement of petroleum hydrocarbons are noted. One point underlined is that sampling, analysis, and interpretation of data are best accomplished by a team of scientists or a scientist having experience in analytical chemistry, marine geochemistry, marine biochemistry, and marine ecology.

ANALYSIS OF HYDROCARBONS IN MARINE ORGANISMS: RESULTS OF IDOE INTERCALIBRATION EXERCISES

Farrington, J. W., J. M. Teal, J. G. Quinn, P. L. Parker, J. K. Winters, T. L. Wade, and K. Burns. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and Workshop, Nat. Bureau of Standards, Maryland, 1974. R. C. Junghans (ed.). NBS Special Publication 409. p.163-166.

Four laboratories analyzed a tuna meal sample from NBS using the techniques and methods employed at that time in the respective laboratories. The methods are outlined, and the results compared. Agreement was fair, but discrepancies are not always from the same laboratory. Intercalibration is needed, even when the same methods of analysis are used.

COMPARISON OF ANALYSIS METHODS FOR HYDROCARBONS IN SURFACE SEDIMENTS

Farrington, J. W., and B. W. Tripp. 1975.
Marine Chemistry in the Coastal Environment. T. M. Church (ed.). Washington, D. C., American Chemical Society, 1975. p.267-284. (ACS Symposium Series, 18)

Three chemical extraction procedures were compared by gravimetric analysis for their efficiency in extracting hydrocarbons from marine sediment samples and were found to be similarly effective. The extracted hydrocarbons were characterized and quantified by gas chromatography. A number of samples were spiked with 10 ppm of No. 2 fuel oil, and gas chromatography was found to be useful in detecting and quantifying the spike.

IDOE-5 INTERCALIBRATION SAMPLE: RESULTS OF ANALYSIS AFTER SIXTEEN MONTHS STORAGE

Medeiros, G. C., and J. W. Farrington. 1974.
Marine Pollution Monitoring (Petroleum) Symposium and
Workshop, National Bureau of Standards, Maryland, 1974.
R. C. Junghans (ed.). NBS Special Publication 409.
p.167-170.

The stability of a petroleum-spiked cod liver lipid extract was tested by analyzing 2 subsamples after 16 months. The analyses from the 2 time periods are in agreement. The wet chemical and instrumental analyses can be done quite adequately by trained laboratory assistants under supervision.

Information Source: J. W. Farrington, Woods Hole Oceanographic
Institution, Main St., Woods Hole, MA
02543

B. OIL POLLUTION PREVENTION AND CONTROL

1. CLEANUP AND RECOVERY

R-006-77

WATER AND SEDIMENT CHEMISTRY

Principal Investigator: Ho, C. L.
Performing Organization: Louisiana State University Systems, Center for Wetland Resources, University Station, Baton Rouge, LA 70803
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sea Grant Office
Period: 7/75 to 6/76
Funds: $19,610

The project is designed to investigate the role of clays and organic matter in oil adsorption and their subsequent precipitation; to find the relative stability of adsorbed hydrocarbon with respect to chemical and biological degradation; to find levels of inorganic nutrient requirements for biodegradation of adsorbed hydrucarbons; and to monitor the secondary chemical changes in surface sediments as a result of chronic oil and wastewater discharges.

[SSIE No. GBP-2278]

R-007-77

PERFORMANCE TESTING OF PROTOTYPE SYSTEMS AND DEVICES TO REMOVE AND SEPARATE SPILLED OIL

Principal Investigator: Unknown
Performing Organization: JBF Scientific Corporation, Lakeside Office Park, Wakefield, MA 01880
Supporting Agency: American Petroleum Institute. No. OS-58
Period: 7/75 to 6/76

The research goal is to design, construct and demonstrate the performance of an open-sea Dynamic Inclined Plane (DIP) oil skimmer.

Status: Construction of the skimmer was completed, certification by the USCG obtained, and test/demonstrations performed in Boston, Harbor in October, 1974. A draft final report on this project was due to be submitted to the task force in November, 1976. Also being prepared is a documentary film of the construction of the skimmer (DIP-4001) and the snakedown, harbor and sea trials.

[SSIE No. PAP-120-1]

R-008-77

PERFORMANCE TESTING OF PROTOTYPE SYSTEMS AND DEVICES TO REMOVE AND SEPARATE SPILLED OIL

Principal Investigator: Unknown
Performing Organization: Shell Pipeline Corporation, 609 Fannin St., Houston, TX 77001
Supporting Agency: American Petroleum Institute. No. 05-5C
Period: 7/75 to 6/76

Research is being conducted to design, fabricate and test scale models of a wave-conforming oil skimming vessel for operation in the open sea and to prepare a preliminary design and cost estimate of a prototype vessel.

Status: Phase I of this project, which consisted of the fabrication and testing of the scale model, has been completed and reviewed with the task force. The second phase, dealing with a full size prototype design meeting architectural specifications and including detailed drawings, is complete. The drawings and specifications were to be transmitted in early October, 1976.

[SSIE No. PAP-121-1]

2. RESTORATION

R-285-75 (renewal)
SHORELINE PROTECTION AND RESTORATION
Principal Investigator: Unknown
Performing Organization: Exxon Research and Engineering Co., 1600 Linden Ave., NJ 07036
Supporting Agency: American Petroleum Institute, No. 05-17A
Period: 7/75 to 6/76

The objective of this project is to conduct a feasibility study on biological methods for protecting shorelines from oil spill contamination and restoring contaminated shorelines.

[SSIE No. PAP-128-1]

Status: The project has been completed and a final report is available through the American Petroleum Institute.

Reports and Publications

SHORESIDE PROTECTION AND RESTORATION FROM OIL SPILLS
Stewart, W. S. 1974.
Final report, API Publication No. 4254. 142p.

Studied were the applicability and utility of microbial preparations and natural plant polysaccharides for the protection and restoration of rocky shorelines and pebbly beaches from oil contamination. These materials were only very slightly effective in restoring rocks that were fouled with oil, particularly very heavy oil. Information has been developed on effective dosage levels to afford protection against oil contamination, methods of application of protecting agents, effects of temperature, duration of the protection offered, and overall efficiency of mircobiological and natural product systems.

Information Source: S. M. Fruh, Exxon Research & Engineering Company, P. O. Box 8, Linden, NJ 07036

R-139-76

BIONOMICS AND ECOLOGY OF THE JACKASS PENGUIN (SPHENICUS DEMERSUS) WITH REFERENCE TO CONSERVATION OF THE SPECIES

Principal Investigator:	Siegfried, W. R.
Performing Organization:	University of Cape Town, Fitzpatrick Institute, Rondebosch 7700, C.P. 7700, Capetown, Cape of Goud Hope, Republic of South America
Supporting Agency:	National Geographic Society
Period:	6/76 to 6/77
Funds:	$30,000

Thousands of jackass penguins are oiled from ships discharging oil at sea. Efforts are being made to rehabilitate them for normal growth in the wild.

In this study, observers will visit certain islands at monthly intervals during 1976 and populations of rehabilitated birds and "normal" birds will be monitored. Resulting data will permit computer analyses aimed at revealing differential mortality and breeding success. Information on the movement of penguins will also be provided.

[SSIE No. BU-678]

Status: Current research includes an evaluation of the success of rehabilitation of cleaned oiled birds by following marked birds in the field and analyzing ring recoveries. This is a long term project and no published results are expected in 1977. Information on the breeding ecology of the species with relevance to conservation is being analyzed at the present time and will be published in 1977.

Reports and Puulications

CONSERVATION OF THE JACKASS PENGUIN (SPHENICUS DEMERSUS (L.))

Frost, P. G. H., W. R. Siegfried, and J. Cooper. 1976. Biological Conservation 9:79-98.

The population of the jackass penguin, which is confined to the coastal waters of southern Africa, has declined in numbers of unknown magnitude since the early 1900's. This review relates current research and conservation efforts to the factors thought to be influencing the population status of the species. These factors include the former exploitation of the birds for their eggs, the disturbance of breeding birds through egg and guano collection, oil pollution, and competition with the fishing industry.

Information Source: J. Cooper, Percy Fitzpatrick Institute of African Ornithology, University of Cape Town, Rondebosch, 7700, Capetown, Cape of Good Hope, Republic of South Africa

3. WASTE TREATMENT AND DISPOSAL METHODS

R-262-74 (renewal)
REFINERY EFFLUENT TREATMENT: (1) ENGINEERING PROCESS DESIGN; (2) INTEGRATED TREATMENT SEQUENCE
Principal Investigators: Grutsch, J. F., and R. C. Mallatt
Performing Organization: Standard Oil Co. of Indiana, 200 E. Randolph Dr., Chicago, IL 60601
Supporting Agency: Standard Oil Co. of California
Period: 1/76 to 1/77

The aim of the engineering process design project is to improve the effectiveness of existing waste treatment processes. Proprietary process designs have been developed which have improved substantially the performance of waste treatment processes by incorporation of unique design and operating features. The integrated treatment sequence program is aimed at determining the optimum sequential end-of-pipe treatment for effluents.

[SSIE Nos. AW-542-1; AW-543-1]

Reports and Publications

OPTIMIZE THE EFFLUENT SYSTEM. PART 1. ACTIVATED SLUDGE PROCESS
Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(3):105-112.

Refinery effluent water quality can be significantly improved and capital and operating costs can be lowered by carefully controlling and integrating the separate elements of a wastewater treatment system. This article, which discusses the activated sludge process, is the first of a series that outlines key objectives and recommends treatment sequences for optimizing refinery wastewater treatment systems.

OPTIMIZE THE EFFLUENT SYSTEM. PART 2. INTERMEDIATE TREATMENT
Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(4):213-218.

Intermediate treatment facilities should be optimized for contaminant reduction and equalization using hydraulic, chemical and physical design considerations. This can be achieved by: using a multiple compartmented basin for hydraulic equalization; monitoring for undesirable contaminants using the first compartment; using the second compartment to maximize oxygen transfer and rate of reaction of oxygen with contaminants by using the same highly mixed compartment for pH control; physically removing flocculated contaminants; destabilizing residual colloidal matter chemically and removing it by filtration; and minimizing retention time to conserve heat.

OPTIMIZE THE EFFLUENT SYSTEM. PART 3. ELECTROCHEMISTRY OF DESTABILIZATION

Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(5):221-230.

The properties of suspended solids in refinery effluents are described, and the objective of colloidal destabilization of suspended particles by chemical treatment is given. Colloid destabilization mechanisms include: colloid entrapment or removal via sweep floc mechanism, reduction in surface charge by double layer repression, bridging by polymers, and charge neutralization by adsorption. Destabilizing chemicals and a destabilization model are topics discussed.

OPTIMIZE THE EFFLUENT SYSTEM. PART 4. APPROACH TO CHEMICAL TREATMENT

Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(6):115-123.

Chemical treatment methods for destabilizing and separating out waterborne colloids from refinery wastewaters are detailed. The colloidal components consist of two basic types: the relatively inert substances such as clay, sand, and organics including oil globules; and micronrganisms or biocolloids. Examples and case histories of the treatment of these major colloidal systems are presented.

OPTIMIZE THE EFFLUENT SYSTEM. PART 5. MULTI-MEDIA FILTERS

Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(7):113-118.

Theoretical and practical aspects of the filtration of petroleum refinery effluents are examined. Filtration mechanisms and chemical treatments that enhance filtration are briefly discussed. The application of filtration technology by the oil industry in the clarification of make-up waters, API separator effluents, aerated lagoon effluents, activated sludge unit effluents, and treatment of cooling and connate water is described.

OPTIMIZE THE EFFLUENT SYSTEM. PART 6. BIOCHEMISTRY OF ACTIVATED SLUDGE PROCESS
Grutsch, J. F., and R. C. Mallatt. 1976.
Hydrocarbon Processing 55(8):137-142.

The fundamental biochemical principles involved in the biodegradation and removal of organic contaminants from (refinery) wastewaters are reviewed.

Information Source: J. F. Grutsch, Standard Oil Co. of Indiana,
200 E. Randolph Dr., Chicago, IL 60601

R-009-77
SOLUBILIZATION AND BIODEGRADATION OF HYDROCARBONS
Principal Investigator: Barnett, S. M., C. W. Houston, and A. R. Thompson
Performing Organization: University of Rhode Island, School of Engineering, Administration Bldg.,
Kingston, RI 02881
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology.
No. B-073-RI
Period: 7/76 to 6/77

The proposed study will concentrate on the transport of hydrocarbons through the aqueous media, which is believed to be the rate controlling factor in the treatment of hydrocarbons. The investigators will identify surfactant characteristics which promote hydrocarbon solubilization, transport and biodegradation, and suggest surfactants for use in waste treatment plants and in natural environments.

[SSIE No. GUY-623]

R-010-77
OIL IN WATER TECHNOLOGY
Principal Investigator: Venezky, D. L.
Performing Organization: U.S. Navy, Research Laboratory,
Washington, D. C. 20390
Supporting Agency: U.S. Department of Defense, Navy.
No. DN580168.
Period: 7/75 to 6/76

In order to maintain naval expertise in the area of oil-in-water detection and assaying, the Naval Research Laboratory (NRL) has participated in reviewing and evaluating test methods which are submitted or proposed to the American Society for Testing and Materials, Committee D-19, and its task group on oil/grease in water. Oil and grease components are being identified, and methods developed to distinguish between soluble non-ionic and soluble ionic hydrocarbons in water. Resulting information will augment NRL's current efforts in oil/water separation technology.

[SSIE No. ZON-5R0168]

4. PREVENTION AND CONTROL MEASURES

R-14-76 (renewal)
OIL SPILLS - THE POLICY OF PREVENTION AND THE STRATEGY OF RECOVERY
Principal Investigator: Conrad, J.M.
Performing Organization: University of Massachusetts, School of Food and Natural Resources, Amherst, MA 01002
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology. No. A-087-MASS
Period: 8/76 to 7/77
Funds: $5,600

The proposed project will survey recent incidents of oil pollution, and review state and national legislation designed to prevent spills and assess its effectiveness. In addition, the study will look into the nature of oil spills recovery technology and construct a model for the allocation of recovery resources so as to be in "the best state of preparedness" in the event of a spill.

[SSIE No. GUY-385-1]

Reports and Publications

OIL SPILLS: THE STRATEGY OF RECOVERY
Conrad, J.M. 1976.
University of Massachusetts, Amherst. Preliminary report, Grant A-087. 38 p.

A model for determining the optimal location of recovery resources is developed and applied to coastal Massachusetts. Nine hypothetical situations were constructed relating to possible petroleum finds on Georges Bank and onshore developments in southeastern Massachusetts. The location of recovery packages was determined for each situation. Priority areas selected for the location of these resources included Cape Cod and the islands of Martha's Vineyard and Nantucket, Boston Harbor, and Plymouth. A desirable financial/operational arrangement would be one in which a recovery system were financed from federal revenue generated by bonus bids and production royalties with recovery operations contracted to private firms.

Information Source: J.M. Conrad, Department of Food and Resource Economics, University of Massachusetts, Amherst, MA 01002

R-011-77

DEVELOPMENT OF WATER POLLUTION CONTROL SYSTEMS FOR PORT AUTHORITY OF NEW YORK AND NEW JERSEY AIRPORTS

Principal Investigator: Pilie, R.J.
Performing Organization: Calspan Corp., 4455 Genesee St., Buffalo, NY 14225
Supporting Agency: New York City Government
Period: 7/75 to 6/76

The Port Authority of New York and New Jersey has retained Calspan Corporation to undertake a comprehensive analysis of the effect of the airport's storm and runoff waters on natural waters adjacent to Kennedy, La Guardia and Newark airports. Extensive precautions and disposal facilities have been utilized at each airport to avoid pollution of these waters. The existing drainage system serving maintenance, fuel and service facilities includes oil separators and catch basins. The two-year program consists of (1) data collection, including an inventory of all chemicals used at the airports; (2) analysis of samples collected and their relationship to environmental quality; (3) determination of immediate preventive and corrective measures; and (4) determination of long-term control systems including alternatives, new treatment processes, and construction of required facilities.

[SSIE No. XNE-93-1]

Status: The project is almost completed and final reports have been submitted to the Port Authority for each of the three airports and for the pilot scale treatment experiments performed on hangar wastes. FFI contact Mr. Andy Attar, The Port Authority of New York and New Jersey, One World Trade Center, Room 64N, New York, NY 10048.

Information Source: R.J. Pilie, Calspan Corporation,
P. O. Box 235, Buffalo, NY 14221

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

R-077-74 (renewal)
INVESTIGATIONS OF THE BREAKDOWN AND SUB-LETHAL BIOLOGICAL EFFECTS OF TRACE PETROLEUM CONSTITUENTS IN THE MARINE ENVIRONMENT
Principal Investigator: Calder, J. A.
Performing Organization: State University of Florida System, School of Arts and Sciences, 205 Wildwood Dr., Tallahassee, FL 32306
Supporting Agency: U.S. National Science Foundation, Division of National and International Programs. No. ID073-09745 A01
Period: 2/76 to 1/77
Funds: $50,000

Three major topics will be covered by this research: the physical factors which control the solubility and physical form of hydrocarbons in seawater; the rates of degradation of petroleum constituents by natural mixed bacterial populations; and uptake of preferred substrates by bacteria and the effects of these molecules on the kinetics of selected enzyme systems.

[SSIE No. GSN-1151-3]

Reports and Publications

EFFECT OF THE WATER SOLUBLE FRACTION OF CRUDE, REFINED AND WASTE OILS ON THE EMBRYONIC AND LARVAL STAGES OF THE QUAHOG CLAM, MERCENARIA SP.
Byrne, C. J., and J. A. Calder. 1977.
Marine Biology. In press.

EFFECT OF DISSOLVED AROMATIC HYDROCARBONS ON THE GROWTH OF MARINE BACTERIA IN BATCH CULTURE
Calder, J. A., and J. H. Lader. 1976.
Applied and Environmental Microbiology 32(1):95-101.

The growth rate and maximum cell density of marine bacteria in batch cultures were found to decrease with increasing concentrations of dissolved aromatic hydrocarbons. Toxicity levels were observed to increase inversely with solubility, and partial oxidation of naphthalene caused complete cessation of growth at high concentrations.

THE SOLUBILITY OF MEDIUM MOLECULAR WEIGHT AROMATIC HYDROCARBONS AND THE EFFECTS OF HYDROCARBON CO-SOLUTES AND SALINITY
Eganhouse, R. P., and J. A. Calder. 1976.
Geochimica et Cosmochimica Acta 40:555-561.

The solubilities of several medium molecular weight hydrocarbons were determined at 25°C in aqueous binary, ternary, and quaternary hydrocarbon systems. Results are presented.

EFFECT OF THE WATER SOLUBLE FRACTION OF OILS ON THE ACTIVITY OF ALKALINE PHOSPHATASE AND PHOSPHODIESTERASE IN A MARINE PHYTOPLANKTON
Fehler, S. W. G., and J. A. Calder. Submitted.

KINETIC ASSAYS FOR ALKALINE PHOSPHATASE AND PHOSPHODIESTERASE IN MARINE PLANKTON
Fehler, S. W. G., and J. A. Calder. Submitted.

THE EFFECT OF WATER SOLUBLE FRACTION OF CRUDE, REFINED AND WEATHERED OILS ON THE GROWTH OF A MARINE BACTERIUM IN BATCH CULTURE
Griffin, L. F., and J. A. Calder. In preparation.

DISSOLVED HYDROCARBONS IN THE EASTERN GULF OF MEXICO LOOP CURRENT AND THE CARIBBEAN SEA
Iliffe, T. M. 1974.
Deep Sea Research 21(6):481-488.

Dissolved non-polar hydrocarbon concentrations of waters collected from various stations and depths in the title areas were determined. The highest concentrations were found to occur in the Florida Strait. Hydrocarbon compositions of the different waters are given.

SOLUBILITY OF ALKYLBENZENES IN DISTILLED WATER AND SEAWATER AT 25.0°C
Sutton, C., and J. A. Calder. 1975.
Journal of Chemical & Engineering Data 20(3):320-322.

Results indicated that for monosubstituted alkylbenzenes, the size of the alkyl substituent is important in determining the solubility; whereas for polysubstituted alkylbenzenes, the positions of the substituents on the benzene ring are also important.

SOLUBILITY OF HIGHER-MOLECULAR-WEIGHT N-PARAFFINS IN DISTILLED WATER AND SEAWATER
Sutton, C., and J. A. Calder. 1974.
Environmental Science and Technology 8:654-657.

The solubility of several n-paraffins has been determined in distilled water and seawater and, in all cases, the paraffins were less soluble in seawater than in distilled. The magnitude of the salting out effect increased with increasing molar volume of the paraffins in accordance with the McDevit Long theory. This effect observed for the n-paraffins indicates the importance of estuaries in determining the geochemical transport and fate of n-paraffins as well as other organic molecules.

Information Source: J. A. Calder, State University of Florida, School of Arts and Sciences, 205 Wildwood Dr., Tallahassee, FL 32306

R-260-74 (renewal)
NAVY ENVIRONMENT - BIOLOGY OF THE MARINE ENVIRONMENT
Principal Investigator: Vedros, N. A., and R. J. Heckly
Performing Organization: University of California, School of Public Health, Berkeley, CA 94720
Supporting Agency: U.S. Department of Defense, Navy. No. DN023238, Contract N00014-75-C-0774
Period: 7/75 to 6/76
Funds: $222,199

The ecological impact of pollutants on the marine and terrestrial environments are being determined and means of controlling and reducing pollution examined. This research includes an investigation of hydrocarbons and heavy metals as water pollutants, with emphasis on the uptake of these pollutants by marine organisms.

[SSIE No. GQN-23238-2]

R-294-75 (renewal)
THE PETROLEUM INDUSTRY IN THE DELAWARE ESTUARY
Principal Investigator: Whipple, W.
Performing Organization: Rutgers The State University, Water Resources Research Institute, Old Queens Bldg., New Brunswick, NJ 08903
Supporting Agency: U.S. National Science Foundation, Division of Advanced Environmental Research and Technology. No. ENV74-14810 A03
Period: 3/74 to 4/77
Funds: $350,000

The nature and sources of petroleum pollutants entering the Delaware estuary in the Philadelphia area will be identified and effects of these pollutants on aquatic biota evaluated.

[SSIE No. GSQ-1892-2]

Status: Previous work has shown that urban runoff and non-petroleum industries contribute more oil pollutants than do the refineries, and current levels of petroleum wastes in the river are harmful to biota. The following areas have been or are presently being studied: effects of water-soluble fractions of crude oil on oysters, effects on other organisms of effluents from the biologically treated wastes of ARCO, petroleum effects on algae and on the nitrification process. The project has been funded by NSF-RANN for three consecutive years. Renewal for programmed fourth and fifth years is anticipated.

Reports and Publications

MEASUREMENT OF URBAN RUNOFF PETROLEUM
Hunter, J. V., S. L. Yu, and W. Whipple, Jr. 1975. Urbanization and Water Quality Control. W. Whipple, Jr. (ed.). Minneapolis, Minnesota, American Resources Association, 1975.

Information Source: New Jersey Water Resources Research Institute, Rutgers University, Annual Report Fiscal Year 1976

R-099-76

CHRONIC EFFECTS OF INGESTED PETROLEUM IN MARINE BIRDS

Principal Investigators: Holmes, W. N., J. Cronshaw, and A. Crocker
Performing Organization: University of California, Santa Barbara, Santa Barbara, CA 93106
Supporting Agency: U.S. Department of the Interior
Period: 1/76 to 1/80
Funds: $187,165

The contract provides for the comprehensive study of the effects of ingested crude oil on the health of marine birds. Adult mallard ducks adapted to seawater are being fed diets containing known concentrations of crude oils from various geographical locations. Factors being monitored include body weight, amounts of food and oil consumed daily, hormonal status of the adrenal glands, and environmental stress. The data are compared with those from control groups fed uncontaminated food.

Reports and Publications

ACUTE AND CHRONIC EFFECTS OF PETROLEUM ON MARINE BIRDS
Holmes, W. N., and J. Cronshaw.
The Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D. C. Malins (ed.). New York, Academic Press. Chapter 5. In press.

Topics covered in this chapter include: effects of spillage on mortality; physical systemic effects; and pathological effects. Studies indicate that mature ducks maintained under laboratory conditions tolerate well the chronic administration of at least two crude oils and one petroleum distillation product. Histological patterns of the adrenal gland in birds treated with oil, however, suggest a higher than normal level of adrenocortical function occurs under conditions of chronic petroleum ingestion. The development of this condition may account for the high mortality in experiments in which birds fed oil-contaminated diets were exposed to cold-stress.

THE EFFECTS OF COLD STRESS ON SEAWATER-MAINTAINED DUCKS GIVEN FOOD CONTAMINATED WITH PETROLEUM
Holmes, W. N., J. Cronshaw, and J. Gorsline. In preparation.

Information Source: J. Cronshaw, Department of Biological Sciences, University of California, Santa Barbara, CA 93106

R-012-77
ACUTE AND CHRONIC TOXICITY OF SEAWATER EXTRACTS OF ALASKA CRUDE OIL TO ZOEAE OF THE DUNGENESS CRAB, CANCER MAGISTER DANA
Principal Investigator: Caldwell, R. S.
Performing Organization: Oregon State University, Marine Science Center, Newport, OR 97365
Supporting Agency: National Oceanic and Atmospheric Administration, National Marine Fisheries Service . NOAA Task Unit No. 3, Contract No. 03-5-022-68.
Period: 7/75 to 9/76
Funds: $38,687

Research was aimed at determining the acute and chronic effects of crude oil, its component fractions, and other petroleum-associated chemicals on physiological and behavioral mechanisms of selected arctic and subarctic organisms.

Reports and Publications

EFFECTS OF A SEAWATER-SOLUBLE FRACTION OF COOK INLET CRUDE OIL AND ITS MAJOR AROMATIC COMPONENTS OR LARVAL STAGES OF THE DUNGENESS CRAB, *CANCER MAGISTER DANA*
Caldwell, R. S., E. M. Caldarone, and M. H. Mallon. 1977. Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Seattle, November, 1976. In press.

Larval stages of *C. magister* Dana were exposed continuously to dilutions of Cook Inlet crude oil water-soluble fraction (WSF) or seawater solutions of naphthalene or benzene for periods up to 60 days. Effects on survival, duration of larval development and size were used as indicators of toxicity. The lowest concentration of WSF at which toxic effects were seen was 4.0% of the full strength WSF (0.0049 mg/l as naphthalene or 0.22 mg/l as total dissolved aromatics). The lowest concentrations at which toxic effects were observed with naphthalene and with benzene were 0.13 mg/l and 1.1 mg/l, respectively. Concentrations of aromatic hydrocarbons in the WSF were inversely related to the degree of alkylation in the benzene and naphthalene families, but acute toxicity was directly related to the degree of alkyl substitution.

Information Source: R. S. Caldwell, Oregon State University, Marine Science Center, Department of Fisheries and Wildlife, Newport, OR 97365

R-013-77
MODE OF UPTAKE AND RATE OF RELEASE OF PETROLEUM HYDROCARBONS BY SHELLFISH IN RELATION TO THEIR PHYSIOLOGICAL CONDITIONS
Principal Investigator: Ho, C. L.
Performing Organization: Louisiana State University Systems, Center for Wetland Resources, University Station, Baton Rouge, LA 70803
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sea Grant Office
Period: 7/75 to 6/76
Funds: $22,010

Research objectives are: to find reliable methods that may readily be adapted for routine analysis by state agencies for distinguishing the naturally occurring hydrocarbons from that of petroleum hydrocarbons in commercially important species (oysters, shrimp, etc.); to examine petroleum hydrocarbon uptake by the filter feeder oysters; to determine the rate of depuration of petroleum hydrocarbons in oysters; to quantify the amount of these compounds that would impair the taste quality; and to determine the effect of oil-coated sufaces on recruitment and growth of young oysters under field conditions

Reports and Publications

IMPACT OF SURFACE ADSORBED PETROLEUM HYDROCARBONS ON ORGANISMS
Ho, C. L., and T. Karim. 1977.
Symposium on Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Seattle, November, 1976. In press.

Information Source: C. L. Ho, Louisiana State University,
Center for Wetland Resources, University
Station, Baton Rouge, LA 70803

R-014-77

EFFECTS OF COMPOUNDS PRODUCED FROM PETROLEUM UTILIZATION ON SELECTED MARINE INVERTEBRATES WITH PARTICULAR REFERENCE TO CARCINOGENESIS

Principal Investigator: Mix, M. C.
Performing Organization: Oregon State University, Department of General Science, Corvallis, OR 97331
Supporting Agency: U.S. Environmental Protection Agency
Period: 6/76 to 6/78
Funds: $129,425

Among the project objectives are: to determine the concentration (body burdens) of selected environmental chemical carcinogens in economically-important molluscs and crustaceans from Oregon waters; to determine if there is a potential public health hazard to man from consuming shellfish which contain petroleum by-products that are carcinogenic; to survey populations of bivalve molluscs, determine the incidence of neoplastic diseases, and ascertain if there is any correlation between carcinogen concentrations and incidence of disease; to determine if metabolic pathways exist in bivalve molluscs which lead to detoxification or modification of benzo(a) pyrene; and to study the fate and acute and chronic effects of benzo(a)pyrene on bivalve molluscs.

Reports and Publications

CHEMICAL CARCINOGENS IN THE MARINE ENVIRONMENT. I. BENZO(A)PYRENE IN ECONOMICALLY-IMPORTANT BIVALVE MOLLUSCS FROM OREGON ESTUARIES
Mix, M. C., R. T. Riley, K. I. King, S. R. Trenholm, and R. L. Schaffer. 1977.
Symposium on Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Seattle, November, 1976. In press.

Benzo(a)pyrene (BAP) levels were determined in economically-important indigenous shellfish populations from several sites in five Oregon bays. Detectable levels of BAP were present in bivalves from 43 of the 44 sampling sites. High levels (> 15 ng/g) were present in mussels collected from the Newport bayfront in Yaquina Bay and from a marina in Tillamook Bay. Significant levels (> 5 ng/g) were present in *Mya arenaria* collected along the shipping docks in Coos Bay.

Information Source: M. C. Mix, Oregon State University, Department of General Science, Corvallis, OR 97331

R-015-77
EFFECT OF CRUDE OIL ON NITROGEN FLUX IN SALT MARSHES
Principal Investigator: Patrick, W. H.
Performing Organization: Louisiana State University Systems, School of Agriculture, University Station, Baton Rouge, LA 70803
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sea Grant Office. No. R/HSE-3
Period: 7/75 to 6/76
Funds: $5,847

Among the objectives of this project are: to elucidate and quantify the relationship between primary productivity and microbial nitrogen fixation, to determine the usefulness of nitrogen fixation and/or microbial nitrogen fixers distribution as indicator organisms for Louisiana's Coastal Zone Management effort, and to determine the effect of crude oil on biological activity of soil as measured by CO_2 production. Knowing the effect of oil on the growth of *Spartina alterniflora*, which is responsible for most of the primary production in Louisiana coastal marsh, will help determine part of the overall effect of petroleum operations on the ecology and productivity of this area.

[SSIE No. GBP-2402]

R-016-77

TOXIC EFFECTS OF OIL IN WATER DISCHARGED FROM SHIPS

Principal Investigator: Unknown
Performing Organization: Exxon Research and Engineering Co., 1600 Linden Ave., Linden, NJ 07036
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

This effort is designed to determine those portions of oil which may be dissolved in water in the shipboard environment, and to examine the toxic effects of both the dissolved oil and dispersed oil discharged overboard on the ecology. The following tasks have been conducted: selection and procurement of last test oils; solubility and dispersability studies; analysis of samples; toxicity studins; and recommendations and reports of work.

[SSIE No. GZ-58374]

Status: The project has been completed and a final report is available through NTIS.

Reports and Publications

TOXIC EFFECTS OF OIL DISCHARGED FROM SHIPS
Frankenfeld, J. W., J. J. Elliott, R. E. Bentley, and B. H. Sleight III. 1976.
Final report, Contract No. DOT-CG-51073-A. 132p.

Six selected petroleum products were studied to determine their dissolution properties in water. Toxicity tests were conducted on two fish and a brine shrimp using dissolved and dispersed oils in water. The results are critically reviewed and contrasted.

Information Source: S. M. Fruh, Exxon Research and Engineering Co., P. O. Box 8, Linden, NJ 07036

R-017-77

STUDIES TO DEFINE THE EFFECTS OF REFINERY WASTES AND OIL TRANSFER FACILITIES ON PACIFIC NORTHWEST MARINE COASTAL ECOSYSTEMS

Principal Investigators: Vanderhorst, J. R., R. M. Geam, and E. A. Crecelius
Performing Organization: Battelle Memorial Institute, P. O. Box 999, Richland, WA 99352
Supporting Agency: U.S. Energy Research and Dev. Administration Biomedical and Environmental Research Division. Contract E(45-1)-1830
Period: 7/75 to 6/76

The program will survey the marine communities at three sites to augment the data base that now exists for the Cherry Point-Anacortes region on the effects of refinery wastes; provide baseline data for the Port Angeles region; and develop baseline data for a region similar to the above areas but not likely to receive refinery wastes, products or crude oil contamination.

[SSIE No. ZPE-11376]

For Reports and Publications see R-212-74, p. 217.

R-018-77

THE EFFECTS OF SPECIFIC MONOAROMATIC HYDROCARBONS ON DIFFERENT LIFE STAGES OF MARINE ORGANISMS, PRIMARILY MARINE FIN FISHES

Principal Investigator: Whipple, J. A. (formerly Struhsaker)
Performing Organization: National Marine Fisheries Service, NOAA, Southwest Fisheries Center, Tiburon Laboratory, 3150 Paradise Dr., Tiburon, CA 94920
Supporting Agency: National Oceanic and Atmoshperic Administration
Period: 1973 to 1976

Reports and Publications

GAS CHROMATOGRAPH TECHNIQUES FOR MEASUREMENT OF MONO-AROMATICS
Benville, Jr., P. E. In preparation.

THE ACUTE TOXICITY OF SIX MONO-CYCLIC AROMATICS TO STRIPED BASS (MORONE SAXATILIS) AND BAY SHRIMP (CRAGO SP.)
Benville, Jr., P. E., and S. Korn.
California Fish & Game Bulletin. In press.

The TL_{50}'s of benzene, toluene, ethylbenzene, p-xylene, m-xylene, and o-xylene ranged from 5.8 to 11 μl/l (ppm) for striped bass and from 0.49 to 20 μl/l for bay shrimp. Solubilities of these aromatics determined by gas chromatography were high enough to be lethal to striped bass and bay shrimp. The toxic effect of the aromatics was more latent in shrimp than in fish as demonstrated by the difference in the 24- and 96-hr tests.

A SIMPLE APPARATUS FOR METERING VOLATILE LIQUIDS INTO WATER
Benville, Jr., P. E., and S. Korn. 1973.
Journal of the Fisheries Research Board of Canada 31(3): 367-368.

"A metering device was developed to introduce benzene, toluene, xylene, and 1,2,4, trimethylbenzene vapors into water using air as a carrier gas. Setting the carrier gas flows for the respective aromatics at 10, 25, 120 and 500 cm^3/min for 2h resulted in concentrations of 8.2, 13.0, 12.0, and 7.2 μl/liter, respectively, in 4 liters of water. The aromatic concentrations were maintained in a static system by bubbling air through the water, and in a continuous flow system by replenishing the water."

RESPIRATORY RESPONSE OF JUVENILE CHINOOK SALMON AND STRIPED BASS EXPOSED TO BENZENE, A WATER-SOLUBLE COMPONENT OF CRUDE OIL SPILLS

Brocksen, R. W., and H. T. Bailey. 1973.
Joint Conference on the Prevention and Control of Oil Spills, Washington, D. C., 1973. No. 4172. p.783-791.

Exposure to sublethal doses of benzene for periods up to 48 hours increased the respiratory rate 115%. Longer exposure casued a decrease due to a reversible narcotic state.

UPTAKE AND DEPURATION OF ^{14}C BENZENE IN THE ROTIFER, *BRANCHIONUS PLICATILUS*

Echeverria, T. Submitted for review.

FATE OF ^{14}C-BENZENE (AN AROMATIC HYDROCARBON OF CRUDE OIL) IN A SIMPLE FOOD CHAIN OF ROTIFERS AND PACIFIC HERRING

Eldridge, M. B., and T. Echeverria. 1977.
To be presented at the Meeting of the American Fisheries Society, Feb., 1977.

FATE OF ^{14}C-BENZENE IN PACIFIC HERRING (*CLUPEA HARENGUS PALLASI*) EGGS, YOLK SAC LARVAE, AND FEEDING LARVAE

Eldridge, M. B., T. Echeverria, and S. Korn. Submitted for review.

RELATIVE UPTAKE RATES OF LOW LEVELS OF ^{14}C BENZENE FROM ROTIFERS AND WATER COLUMN--PACIFIC HERRING LARVAE

Eldridge, M. B., T. Echeverria, and S. Korn. In preparation.

EFFECTS OF META-XYLENE (A WATER-SOLUBLE COMPONENT OF CRUDE OIL) ON EMBRYOS AND LARVAE OF PACIFIC HERRING

Eldridge, M. B., J. A. Struhsaker, and T. Echeverria. Submitted for review.

EFFECTS OF MONO-AROMATICS ON ENERGY UTILIZATION OF PACIFIC HERRING EGGS, EMBRYOS, LARVAE

Eldridge, M. B., J. A. Struhsaker, and T. Echeverria.
Transactions of the American Fisheries Society. In press.

IDENTIFICATION AND QUANTIFICATION OF MONO-AROMATICS IN OUTBOARD ENGINE GASOLINE

Hirsch, N., P. E. Benville, Jr., and Obrebski.
First draft manuscript complete.

SEMI-CLOSED SEAWATER SYSTEM WITH AUTOMATIC SALINITY, TEMPERATURE, AND TURBIDITY CONTROL

Korn, S. 1975.
NOAA Technical report, National Marine Fisheries Service, SSRF-694. 5p.

Summary not available.

THE EFFECTS OF BENZENE ON THE GROWTH, FAT CONTENT, AND CALORIC CONTENT OF STRIPED BASS (*MORONE SAXATILIS*)

Korn, S., J. A. Struhsaker, and P. E. Benville, Jr. 1976.
Fishery Bulletin 74:694-698.

Experiments were conducted to determine if sublethal levels of benzene, although not inducing death, would inhibit energy utilization by striped bass. Definite effects of benzene on growth parameters were noted at 6.0- and 3.5 µl/l levels of benzene. Although the fish may be able to adapt by metabolic detoxification and depuration of benzene, after more prolonged periods the competetive effects on energy utilization may not only decrease growth but also increase mortality or reduce ability to withstand environmental stress.

UPTAKE, DISTRIBUTION AND DEPURATION OF ^{14}C BENZENE AND ^{14}C TOLUENE IN PACIFIC HERRING (*CLUPEA PALLASI*)

Korn, S., N. Hirsch, and J. A. Struhsaker. 1977.
Fishery Bulletin. (January issue).

Summary not available.

UPTAKE, DISTRIBUTION AND DEPURATION OF ^{14}C BENZENE IN NORTHERN ANCHOVY (*ENGRAULIS MORDAX*) AND STRIPED BASS (*MORONE SAXATILIS*)

Korn, S., N. Hirsch, and J. A. Struhsaker. 1976.
Fishery Bulletin 74(3):531-551.

The two species of marine fish were exposed to sublethal concentrations of ^{14}C-benzene for 48 hours, and residues in tissues exhibiting a high lipid content or representing apparent major metabolic sites were measured during and after exposure. Fish exhibited a rapid uptake over a wide range of benzene concentrations in the water column. Accumulation in anchovy was considerably greater than in striped bass. Results indicate that the pathway of hydrocarbons through the liver, gallbladder, intestine, and colon is a major depuration route. Residues were depurated rapidly after exposure; in striped bass most residues were undetectable by seven days.

THE ACUTE TOXICITY OF BENZENE, A COMPONENT OF CRUDE OIL

Meyerhoff, R. D. 1975.
Journal of the Fisheries Research Board of Canada 32(10): 1864-1866.

The acute toxicity of benzene to 1.5 ± 0.5 gm juvenile striped bass was studied in a continuous flow laboratory bioassay system. The lethal threshold concentration and the 96-hr LC$_{50}$ for benzene were both 10.9 $\mu l/l$, when the environmental conditions were at 17.4C and 29 ppt salinity. Possible toxic mechanisms are discussed.

EFFECTS OF BENZENE (A TOXIC COMPONENT OF CRUDE OIL) ON SPAWNING PACIFIC HERRING

Struhsaker, J. A. 1977.
Fishery Bulletin. (January issue).

Summary not available.

REVIEW PAPER ON THE EFFECTS OF MONO-AROMATICS ON FISH

Struhsaker, J. A.
First draft manuscript complete.

EFFECTS OF BENZENE (A WATER-SOLUBLE COMPONENT OF CRUDE OIL) ON EGGS AND LARVAE OF PACIFIC HERRING AND NORTHERN ANCHOVY

Struhsaker, J. A., M. B. Eldridge, and T. Echeverria. 1974.
Pollution and Physiology of Marine Organisms. F. J. Vernberg, and W. B. Vernberg (eds.).
New York, Academic Press, 1974. p.253-284.

Eggs and larvae of herring and anchovy were exposed to benzene for longer than 24 hours and up to seven days. Egg survival decreased, the number of abnormal larvae increased, and larval respiration increased. In the herring, larval development decreased but anchovy development accelerated. The LC_{50} value of benzene for the anchovy eggs was 20-25 ppm.

R-019-77

TRANSPORT, RETENTION AND EFFECTS OF TOXIC PETROLEUM HYDROCARBONS IN EXPERIMENTAL FOOD CHAINS

Principal Investigator: Whipple, J. A. (formerly Struhsaker)
Performing Organization: National Marine Fisheries Service,
NOAA, Southwest Fisheries Center,
Tiburon Laboratory, 3150 Paradise Dr.,
Tiburon, CA 94920
Supporting Agency: U.S. Department of Interior,
Bureau of Land Management
Period: 6/76 to 1979

The investigator proposes to conduct a series of laboratory experiments to determine the physiological, histological, and morphological effects at certain chronic and acute concentrations of petroleum components. By exposing marine organisms at time of reproduction, estimates of effects on populations can be derived. Part of a benthic community food chain will be studied so that prediction of potential effects of food chain accumulation and effects at a community level will be possible. For the first 18 months, starry flounder (*Platichthys stellatus*), Dungeness crab (*Cancer magister*), and razor clam (*Siliqua patula*) are to be studied. Data obtained from the project will be used to forecast damage to the marine biota in areas of proposed offshore oil development, and to develop *a priori* recommendations before development ensues.

Status: Work is currently underway, and the first formal manuscripts should be available sometime in Calendar year 1977.

Information Source: J. A. Whipple, Southwest Fisheries Center,
Tiburon Laboratory, 3150 Paradise Dr.,
Tiburon, CA 94920

2. ECONOMIC EFFECTS

R-020-77
THE ECONOMICS OF PROHIBITING OIL DUMPING AT SEA
Principal Investigator: Heaver, T. D.
Performing Organization: University of British Columbia, 2075 Wesbrook Pl., Vancouver, British Columbia V6T 1W5, Canada
Supporting Agency: University of British Columbia
Period: 7/75 to 6/76

The research objectives are to estimate the cost of prohibiting the dumping of oil at sea and to indicate the distribution of the costs.

[SSIE No. 81-100246]

Status: A monograph is forthcoming in the spring of 1977.

Information Source: T. D. Heaver, University of British, 2075
Wesbrook Pl., Vancouver, British Columbia
V6T 1W5, Canada

3. GENERAL EFFECTS

R-085-74
THE SEDIMENT ENVIRONMENT OF PORT VALDEZ, ALASKA AND THE EFFECT OF OIL ON THIS ECOSYSTEM

Principal Investigator:	Feder, H. M.
Performing Organization:	University of Alaska, School of Biological Sciences, College, AL 99701
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research and Development. No. 800944
Period:	7/72 to 6/74

The project proposes to obtain baseline information concerning the mudflat ecosystems of Port Valdez by studying the physical, chemical and biological characteristics of the sediments. The effects of Prudhoe Bay crude oil on these parameters will be examined.

[SSIE No. GMA-1648]

Reports and Publications

THE SEDIMENT ENVIRONMENT OF PORT VALDEZ, ALASKA: THE EFFECT OF OIL ON THIS ECOSYSTEM
Feder, H. M., L. M. Cheek, P. Flanagan, S. C. Jewett, M. H. Johnston, A. S. Naidu, S. A. Norrell, A. J. Paul, A. Scarborough, and D. Shaw. 1976.
Final report, EPA-600/3-76-086; Contract R800944 02-0. 348p.

In the title investigation, physical, geological, geochemical, hydrocarbon, and biological features were examined. Bacterial populations were unaffected by single applications of up to 2000 ppm of Prudhoe Bay crude oil or chronic exposures. Three species of copepods exposed to oil in the field significantly increased in density in experimentally oiled plots. In studies of oil uptake and release in intertidal sediments and in the clam, *Macoma balthica*, petroleum was not detectable two months after application to sediments. A significant increase in mortality was noted for *M. balthica* exposed to oil. It is suggested that this widely distributed clam may be a valuable indicator for oil.

R-021-77

ENVIRONMENTAL ASSESSMENT OF NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA

Principal Investigator: Harris, H. S.
Performing Organization: Environmental Research Laboratories, National Oceanic and Atmospheric Administration, 3711 15th Ave., N.E., Seattle, WA 98105
Supporting Agency: U.S. Environmental Protection Agency
Period: 9/75 to 9/80 (est.)

The project is designed to provide the ecological data required for making management decisions concerning regional development and for assessing the potential impact of petroleum hydrocarbons on the ecosystem. Output products will include: description of existing ecological and environmental conditions, the present occurrence and variability of petroleum related pollutants, a state-of-art oil spill trajectory model for northern Puget Sound and Strait of Juan de Fuca, and an ecosystem model to provide prediction of fate and effects of selected pollutants on components of the marine ecosystem.

Status: The investigators have just completed their first year of work and are preparing reports to the supporting agency. These reports, as well as papers and presentations, will become available in 1977.

Information Source: H. S. Harris, Environmental Research Laboratories, National Oceanic and Atmospheric Administration, 3711 15th Ave., N.E., Seattle, WA 98105

D. FATE OF OIL IN THE ENVIRONMENT

1. BIODEGRADATION

R-300-75 (renewal)
BIODEGRATION OF OIL IN SOIL
Principal Investigator: Unknown
Performing Organization: Sun Ventures Inc., 240 Rodnor Chester Rd., Wayne, PA 19087
Supporting Agency: American Petroleum Institute. No. OS-21.3
Period: 7/75 to 6/76

Methods are being developed to speed up biodegradation of crude oils and crankcase oils; and determinations are being made of the possible detrimental effects of oil disposal, including waste lube oils, by the land spreading process. Sites for the disposal process include Marcus Hook, Pennsylvania; Tulsa, Oklahoma; and Corpus Christi, Texas.

Status: Preparation of soil plots and application of oils (100 bbls/acre) and fertilizers were completed in January, 1974. After eight months the following decomposition of oil by weight was noted: heavy Arabian crude, 38%; service station waste crankcase oils, 57%; diesel truck waste crankcase oils, 49%; Gulf Coast crude mix, 49%; No. 6 fuel oil, 29%; No. 2 fuel oil, 79%.

[SSIE No. PAP-131-1]

Reports and Publications

BIODEGRADATION OF HIGH-OCTANE GASOLINE
Jamison, V.W., R.L. Raymond, and J.O. Hudson. 1976. International Biodegradation Symposium, 3rd, 1976. J.M. Sharpley and A.M. Kaplan (eds.). Barking, Essex, England, Applied Science Publishers, 1976. p. 187-196.

Groundwater contaminated with gasoline was treated with fertilizer to enhance biodegradation. Cultures isolated from the groundwater were evaluated for their ability to degrade gasoline. Several components did not appear to be utilized for growth, which raises the question of whether complete degradation of the gasoline is possible.

BIODEGRADATION OF HIGH-OCTANE GASOLINE IN GROUNDWATER

Jamison, V.W., R.L. Raymond, and J.O. Hudson, Jr. 1975.
Developments in Industrial Microbiology 16:305-312.

Microbial degradation was studied as a possible means of removing the remaining gasoline in the contaminated water supply of Amber, Pennsylvania, after a gasoline pipeline leak. Laboratory studies showed there was a small microbial population that could utilize high-octane gasoline as the sole carbon source, but nitrogen, phosphate and oxygen were limiting factors for maximum utilization. Results of analyses of the water after the addition of fertilizer and air to several wells are discussed.

OIL DEGRADATION IN SOIL

Raymond, R.L., J. O. Hudson, and V.W. Jamison. 1976.
Applied and Environmental Microbiology 31(4):522-535.

The biodegradation of six oils was studied at three widely separated geographical locations to determine the environmental effects of adding petroleum products to field soil. Concentrations had decreased significantly from the initial application of the previous year and the rate of degradation did not exceed 2.4 $m^3/4 \times 10\ m^2$ per month. Plant growth was inhibited and no oil loss was observed via water movement in the soil.

Information Source: R.L. Raymond, Suntech, Inc., P. O. Box
1135, Marcus Hook, PA 19061

2. GENERAL FATE OF OIL

R-076-74 (renewal)

TRANSFER OF PETROLEUM RESIDUES IN SARGASSUM COMMUNITIES AND THE WATERS OF THE SARGASSO SEA

Principal Investigator: Butler, J.N., and B.F. Morris
Performing Organization: Bermuda Biological Station for Research, St. George, St. George West, Bermuda
Supporting Agency: U.S. National Science Foundation, Division of Ocean Sciences. No. OCE76-15133
Period: 6/76 to 10/77
Funds: $52,400

Work proposed here includes: laboratory studies of rates and pathways of petroleum residue degradation and dispersion; efforts to further quantify the relative amounts of dissolved, particular and adsorbed hydrocarbon in the water column; estimates of some poorly known fluxes of open-ocean hydrocarbons; and carbon content of *Sargassum* organisms (hydrocarbons absorbed in the tissues vs. hydrocarbons passing through the gut).

[SSIE No. GSN-838-4]

R-212-74 (renewal)

FATE AND EFFECTS OF OIL AND OIL COMPOUNDS ON MARINE COASTAL ECOSYSTEMS

Principal Investigator: Vanderhorst, J.R., R.M. Bean, J.W. Blaylock, and L.J. Moore
Performing Organization: Battelle Memorial Institute, P. O. Box 999, Richland, WA 99352
Supporting Agency: U.S. Energy Research and Development Administration, Biomedical and Environmental Research Division
Period: 7/75 to 6/76

An integrated biological/chemical program is being conducted to study the fate of oil components in marine environments and their effects on biological community structure. Specific areas of study include: acute, chronic and sublethal effects of oil following its release to the environment; development of analytical capability to identify and quantify the saturate and aromatic compound types in water, sediments and biological tissue; fate of petroleum in the water column as a function of origin, dispersion, solubility and other parameters; accumulation, retention, and subsequent transfer of oil components by the food web; and fate of petroleum as influenced by microbial degradation in the water column and sediments.

[SSIE No. ZPE-11024-1]

Reports and Publications

CONTINUOUS-FLOW APPARATUS FOR USE IN PETROLEUM BIOASSAY
Vanderhorst, J. R., C. I. Gibson, L. J. Moore, and P. Wilkinson. 1977.
Bulletin of Environmental Contamination and Toxicology 17(5). In press.

Summary not available.

THE ROLE OF DISPERSION IN FUEL OIL BIOASSAY
Vanderhorst, J. R., C. I. Gibson, and L. J. Moore. 1976.
Bulletin of Environmental Contamination and Toxicology 15(1):93-100.

The research objective was to measure aqueous phase concentrations of No. 2 fuel oil and mortality of coon stripe shrimp (Pandalus danae) when three different methods of oil-seawater contact were used. In these methods, identical volumes of oil and water resulted in significant differences in observed mortality and measured amounts of oil in the water column, either as total or soluble oil.

TOXICITY OF NO. 2 FUEL OIL TO COON STRIPE SHRIMP
Vanderhorst, J. R., C. I. Gibson, and L. J. Moore. 1976.
Marine Pollution Bulletin 7(6):106-108.

"Bioassay of a No. 2 fuel oil dispersion with shrimp in a continuous flow system using measured waterborne oil as the indicator of oil concentrations reveals a treatment more definable than those previously described in terms of volume ratios and produces lower lethal concentrations. Shrimp 96-h LC_{50} was 0.8 mg/l in this study as compared to values from 1.5 to 50 mg/l reported for other methods. Mean concentrations in tests do not give significant differences in concentration with respect to day of the test or spatial distribution in the exposure tanks."

Information Source: J. R. Vanderhorst, Battelle Pacific Northwest Division, Marine Research Laboratory, Route 5, Box 1000, Sequim, WA 98382

R-270-74
SOURCE, TRANSPORT AND FATE OF PETROLEUM HYDROCARBONS IN MARINE EFFLUENT
Principal Investigator: Quinn, J.G.
Performing Organization: University of Rhode Island, School of Oceanography, Administration Bldg., Kingston, R.I. 02881
Supporting Agency: U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Period: 7/75 to 6/76

Research has been conducted to measure the input and determine the source of petroleum hydrocarbons entering the Providence River from the Field's Point Treatment Plant sewage effluent. The association of petroleum hydrocarbons with humic-like substances in sewage effluent, suspended matter, and sediments from the Providence River and upper Narragansett Bay is also being investigated.

[SSIE No. GBP-1577-1]

R-022-77
COASTAL SEDIMENTOLOGY
Principal Investigator: Clifton, H.E.
Performing Organization: U.S. Department of the Interior, Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025
Supporting Agency: U.S. Department of the Interior, Geological Survey, Geological Division, No. 9460-00984
Period: 7/75 to 6/76

Included in the project plans are facies analysis of estuarine deposits; a study of sand transport in the estuarine system of Willapa Bay, Washington; studies of the hydrodynamic effects of waves on sedimentation and the mechanics of beach sedimentation; research on the distribution of spilled oil in nearshore systems and the physical and chemical changes in oil attendant with beach and nearshore processes; and studies of nearshore sedimentation of the coast of Alaska and the effect of storm surges. The results of coastal reconnaissance of the Bering Sea from the previous year will be analyzed and compiled for publication

[SSIE No. ZUA-3981]

Status: Present studies of oil in the beach-nearshore system are just beginning.

Information Source: H.E. Clifton, U.S. Department of the Interior, Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025

SECTION III: CURRENT CONFERENCES

*Additional information not available at time of publication

Oct. 5-8 Atlantic States Marine Fisheries Commission Annual Meeting, 35th, Williamsburg, Virginia, 1976.

The meeting dealt primarily with regional fisheries management.

Oil Pollution Related Papers

First General Session

COMPATIBILITY OF OIL AND GAS DEVELOPMENT AND FISHING ON THE ATLANTIC SEABOARD, WITH PARTICULAR REFERENCE TO SOUTHEASTERN U.S. CONTINENTAL SHELF
Johnston, J. B.

OCS oil leasing policies of the U.S. Bureau of Land Management are outlined. Changes over the last decade in leasing procedures which are relevant to environmental protection, especially fisheries resources, are detailed. Possible adverse and positive impacts of OCS oil development on offshore, nearshore, and onshore fisheries resources are briefly reviewed.

FFI contact the Atlantic States Marine Fisheries Commission, 1717 Massachusetts Ave., N.W., Washington, DC 20036.

Oct. 18-21 Petroleum Section Session of the 1976 National Safety Congress, Chicago, Illinois, 1976.

Oil Pollution Related Discussion and Workshop Sessions

Session 137: Exploration, Drilling and Production, and Offshore
Stegall, D. E., presiding

SAFETY AND HEALTH REGULATIONS FOR OUTER CONTINENTAL SHELF
Benkert, W. M., and R. W. Vaughan

OFFSHORE SAFETY-IN HOSTILE ENVIRONMENTS
Klunick, C. H.

OFFSHORE DRILLING AND ITS SAFETY PROBLEM
Goolsby, B.

FFI contact Hal Yurttas, Section Administrator, National Safety Council, 425 No. Michigan Ave., Chicago, IL 60611.

Nov. 2-3 Annual Aquatic Toxicity Workshop, 3rd, Halifax, Nova Scotia, 1976.
Sponsored by the Toxicity Evaluation Section of the Environmental Protection Service, Environment Canada (Atlantic Region).

The theme of the workshop was entitled, Bioassay Protocols: Standardization and Analysis

Oil Pollution Relevant Papers

Session 3

AN EVALUATION OF DEATH BY HYPOXIA AS AN INDICATOR OF TOXICITY OF OIL DISPERSANTS
Payne, J. F., and J. W. Kiceniuk

Commercial oil spill dispersants were tested to evaluate the possibility of a correlation between their toxicity and oxygen tension after death by hypoxia. Most dispersants did not change the oxygen tension at death of a pelagic marine fish, Mallotus villosus, even at concentrations of 2000-2500 ppm. It is concluded that oxygen tension after death by hypoxia may not be a reliably sensitive indicator for general use in toxicity studies.

FFI regarding proceedings contact Ms. Cheryl Sawler, Secretary, Aquatic Toxicity Workshop Committee, Environmental Protection Service, 5151 George Street, Halifax, Nova Scotia B3J 1M5, Canada.

Nov. 8-10 Regional Marine Oil Pollution Conference - Australia, Brisbane, Australia, 1976.
Sponsored by the Australian Government, Department of Transport; the Australian Institute of Petroleum, Petroleum Institute Environmental Conservation Executive; and the Queensland Government, Department of Harbours and Marine.

Oil Pollution Related Papers

Session 1

OIL POLLUTION OF THE SEA - THE WORLDWIDE SCENE (keynote address)
Smith, J. W.

For summary see Section I; C-0322-77.

Session 2

TANKERS - SAFETY AND THE ENVIRONMENT
Dickson, A. F.

For summary see Section I; C-0128-77.

OFFSHORE ACTIVITIES AND THE ENVIRONMENT
McGill, S. R., and I. S. Spottiswood

For summary see Section I; C-0358-77.

OIL SPILL CLEAN-UP--APPLICATION OF EQUIPMENT AND METHODS
Brackley, P. G., and P. J. Holmes

For summary see Section I; C-0239-77.

Session 3

THE CURRENT STATE OF OIL POLLUTION PREVENTION AND CONTROL IN THE UNITED STATES AND CANADA
Horn, S. A.

For summary see Section I; C-0245-77.

THE SITUATION IN JAPAN
Yamaguchi, T.

For summary see Section I; C-0023-77.

MARINE OIL POLLUTION LEGISLATION--WESTERN EUROPE
Brackley, P. G., and C. T. Savin

For summary see Section I; C-0239-77.

Session 4

EVALUATION OF THE ENVIRONMENTAL IMPLICATIONS OF OIL SPILL DISPERSANTS
Gilmour, A. J., and D. Negilsky

For summary see Section I; C-0280-77.

EFFECTS OF OIL ON THE MARINE ENVIRONMENT
Baker, J. M.

For summary see Section I; C-0263-77.

MARINE POLLUTION--LEGAL AND FINANCIAL ASPECTS
Holmes, P. R.

For summary see Section I; C-0431-77.

FFI contact Mr. A. L. Matzkows, Secretary, Petroleum Institute Environmental Conservation Executive, P. O. Box 740, North Sydney, NSW 2060, Australia.

Nov. 17-20 The Coastal Society Annual Conference, 2nd, New Orleans, Louisiana, 1976.

The theme of the conference was "Stressed Coastal Environments: Assessment and Future Action."

Oil Pollution Related Papers

Session on Hydrocarbon Stress in Coastal Wetlands

OIL IN THE COASTAL ENVIRONMENT
Frey, G.

Sources of oil in the marine environment are reviewed. Major inputs of oil result from urban runoff, discharge from marine vessels of all kinds, and onshore and marine seeps. Petroleum exploration and production in the coastal zone are believed to account for only minor pollution. Intense contamination of beaches and coastal marshes along the Atlantic Coast and Gulf of Mexico, which resulted from the many tanker sinkings during World War II, are discussed.

PERMITS, RULES, REGULATIONSIN THE COASTAL ZONE
Clotworthy, H.

Federal and state environmental laws and EPA, Coast Guard, and Corps of Engineers regulations covering petroleum industry operations in coastal areas of Louisiana are discussed beginning with the Rivers and Harbors Act of 1899. The environmental requirements and permits which must be followed in the drilling of a wildcat well and construction of production facilities are summarized.

PETROLEUM OPERATIONS IN THE LOUISIANA MARSH
St. Amant, L.

Petroleum operations in the Louisiana marsh are reviewed, and the role of the Louisiana Wildlife and Fisheries Department is discussed.

FIELD STUDIES ON MARINE LIFE INHABITING AREAS OF CHRONIC LOW-LEVEL EXPOSURE TO PETROLEUM
Mertens, E. W.

Several field studies of the effects of offshore oil production upon marine life are cited which suggest that low-level chronic exposure to oil has little or no measurable adverse health effects on local marine communities, and that in some areas the abundance and diversity of marine life has increased in the vicinity of offshore platforms.

OIL IN THE CALIFORNIA MARSHES
Straughan, D.

The effects of hydrocarbons from weathered oil on the distribution and abundance of species in California marshes are reported. The characteristics and origin of the contaminant oil are the subject of an upcoming study.

FFI contact Dr. James Coleman, Coastal Studies Institute, Louisiana State University, Baton Rouge, LA 70803.

*Nov. 23 One-day Symposium on Pollution Monitoring, London, 1976.

FFI contact H. L. Bennister, The Chemical Society, Burlington House, London W1V 0BN, England.

Nov. 28- Dec. 2 American Institute of Chemical Engineers Annual Meeting, 69th, Chicago, Illinois, 1976.

Oil Pollution Related Papers

Symposium 6: Fundamental Research and Water Pollution Control

Paper 6c
LEACHING RATES OF WATER SOLUBLE MATERIAL FROM RETORTED OR BURNED OIL SHALE
Parker, H. W., R. M. Bethea, J. C. Watts, N. Guven, and M. H. Gazdar

Small quantities of oil shale were experimentally retorted at various temperatures and then used to determine aqueous leaching rates. The data are interpreted and tentative conclusions regarding environmental impacts of in situ oil shale retorting are presented.

Paper 6e
SOLVENT EXTRACTION FOR REMOVAL AND RECOVERY OF ORGANICS FROM REFINING AND PETROCHEMICAL WASTEWATERS
Earhart, J. P., K. W. Won, H. Y. Wong, J. M. Prausnitz, and C. J. King

Solvent extraction is evaluated for removal and recovery of organic materials from refinery and petrochemical wastewaters. Results are presented for removal of COD and specific components from a number of different industrial wastewaters.

Symposium 24: Refinery Wastewater Treatment by Fixed Film Reactor

Paper 24a

USE OF ROTATING BIOLOGICAL SURFACE (RBS) FOR REFINERY WASTEWATER TREATMENT

Flann, G. E., and R. E. Gerhard

Operational data of the EPCO-Hormel Rotating Biological Surface, which is used in the treatment of petroleum refinery wastewaters, are presented; a review of tests in over 20 different refineries is included.

Paper 24b

DESIGN CRITERIA FOR PHENOL TREATMENT BY PLASTIC MEDIA TRICKLING FILTERS

Joyce, T. W.

Case histories of treatment of refinery wastewaters containing phenol by plastic media trickling filters are presented. Design criteria for the treatment of high and low phenol concentrations are discussed.

Paper 24c

OPTIMUM APPLICATIONS OF FIXED FILM REACTORS IN WASTE TREATMENT FLOWSHEETS

Richardson, S. E.

"The paper explores the advantages and limitations of fixed film reactors, specifically as applicable to refinery wastewater treatment. Economic, performance, and physical characteristics are discussed on which to base flowsheet selections for upgrading existing facilities and new facility design."

Symposium 43: Refinery Wastewater Treatment by Granular Media Filtration

Paper 43a

DUAL MEDIA FILTRATION FOR TREATMENT OF REFINERY WASTEWATER

Kempling, J. C., and J. Eng

"Experience of an Imperial Oil Refinery in the pilot study of a dual media, gravity flow, filter on the effluent of an API separator prior to secondary treatment is related. Based on the pilot data, a dual-media filter system was constructed to treat 6MGD/day. Data from the first year of operation will be presented."

PERFORMANCE OF DUAL MEDIA FILTERS ON REFINERY WASTEWATER
Lumpkins, B. J., and M. A. Brody

"Removal efficiencies of various wastewater parameters are examined over a three year operating period at the BP Oil Refinery at Marcus Hook, PA. Maintenance requirements and systems reliability are presented along with a physical description of the filter units and their control system."

Paper 43e
PILOT SCALEUP RESULTS ON GRANULAR MEDIA FILTRATION
Lash, L.

"Suspended solids and oil are effectively removed from wastewaters, such as oily discharges and biological effluents, by granular media (G.M.) filtration. Oil emulsions may require coagulation and flocculation for complete removal. Existing refinery installations are reviewed and scaleup factors investigated, leading to practical sizing of G.M. filters."

FFI contact D. T. Wasan, Illinois Institute of Technology, IIT Center, Chicago, IL 60616.

Dec. 1-3 American Chemical Society Southwest Regional Meeting, 32nd, Fort Worth, Texas, 1976.

Oil Pollution Related Papers

Division of Environmental Chemistry

Paper 12
ALIPHATIC HEAVY HYDROCARBON COMPOSITION IN THE BENTHIC MACROEPIFAUNA OF THE SOUTH TEXAS OUTER CONTINENTAL SHELF
Giam, C. S., H. S. Chan, and G. S. Neff

A program of monitoring heavy hydrocarbon levels and their distribution in the benthic macroepifauna of oil exploration areas of the South Texas Outer Continental Shelf initially focused on the acquisition of baseline data for the *n* paraffins (C_{14-34}). Average concentrations of the n paraffins were found to range from 0.06 ppm in shrimp to 2.64 ppm in lizardfish; the paraffins were characteristic of biogenic hydrocarbons.

Paper 13
MOLECULAR AND ISOTOPIC COMPOSITION OF LIGHT HYDROCARBON GAS IN THE MISSISSIPPI DELTA REGION
Bernard, B. B., J. M. Brooks, and W. M. Sackett

High concentrations of dissolved light hydrocarbons from natural and man-derived inputs are present in Mississippi Delta waters. Petroleum refinery and petrochemical plant waste waters contribute methane containing up to 10% ethane and other light alkanes; whereas biogenic gases forming in Delta sediments are almost entirely methane and CO_2. Isotopic compositions of the two types of methane also differ significantly. Samples from various sites across the delta indicate that man-derived alkanes comprise more than 80% of the dissolved hydrocarbons in the river, and this component is almost completely masked by biogenic methane in Gulf waters.

Abstracts are available at $5 per set from Mr. Max Courtney, Criminalistics Laboratory, Fort Worth Police Department, 1000 Throckmorton, Fort Worth, TX 76102.

*Dec. 1-6 International Symposium on Coastal Problems: Planning, Pollution, and Productivity, Salvador, Brazil, 1976.

FFI contact the Institute of Biology, Federal University of Bahai, Ondina-Salvador 40,000, Bahia, Brazil.

*Dec. 7-9 International Offshore Technology Conference and Exhibition, Birmingham, England, 1976.
Sponsored by the Institute of Petroleum, London, Society of Underwater Technology, and others.

FFI contact the Institute of Petroleum, 61 New Cavendish St., London W1M 8AR, England.

*Dec. 13-18 International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Trinidad, 1976.

FFI contact the Secretariat, Intergovernmental Oceanographic Commission, UNESCO, Place de Fontenoy 75700, Paris, France.

Dec. 14-15 Workshop on Oil Spill Prevention and Clean-up Procedures, Thunder Bay, Ontario, 1976.

The purpose of the workshop was to review current information on oil spill prevention and clean-up procedures, with special emphasis on the unique problems of Northern Ontario.

Oil Pollution Related Papers

Session - December 14

ECOLOGICAL IMPLICATIONS OF SPILLS
Pitura, L. F.

The biological effects of spills and the effect of subsequent clean-up action on aquatic organisms, wildlife and the environment are noted. The positive and negative aspects of the use of chemical oil spill dispersants are discussed.

DYKING OF BULK STORAGE FACILITIES
Thornton, D.

Information on the state of the art on diking technology, which is used in oil storage facilities, is presented. Special reference is given to subarctic to arctic soil conditions.

OIL RECOVERY UNITS
Solsberg, L.

The results of the 1976 Halifax small skimmer evaluation program are discussed, including the efficiency of skimmers when exposed to different petroleum products and weather conditions.

CONTAINMENT PROCEDURES
Beckett, C. J.

The importance of oil spill containment cannot be underestimated. Commercially available and home-made barriers which are applicable for use in a small lake, stream, or river situation are discussed.

SELECTION CRITERIA ON OIL SPILL SORBENTS
Solsberg, L.

Twenty types of sorbents were evaluated with respect to performance and operation criteria when exposed to different oil products. The interrelationship between the effectiveness and unit cost for each material is discussed.

THE EFFECTS OF PETROLEUM SPILLS ON GROUNDWATER
Hore, R. C.

Methods to prevent and control groundwater pollution as a result of an oil spill are discussed, including detection and monitoring techniques.

CRITERIA FOR DISPOSAL
Wood, G. M.

Some of the parameters which influence the disposal of oil and oil-contaminated materials from a spill site are reviewed. Disposal practices that reduce the possibility of re-entry of the oil into the environment are noted.

PROBLEMS ASSOCIATED WITH WINTER CLEAN-UP OPERATION
Logan, W. J.

An overview is presented of special operational problems and difficulties encountered in spill cleanup procedures under freezing conditions and/or ice-infested waters.

Session - December 15

ONTARIO CONTINGENCY PLAN
Belling, P. G.

The responsibilities of the polluter and co-signatory departments are discussed, and the interrelationship of all the proponents is noted.

FEDERAL RESPONSIBILITIES FOR RESPONDING TO SPILLS
Vanderkooy, N.

The commitments of the federal government in administering the International Canada - U.S. Contingency Plan are reviewed, and the responsibilities of a federal facility in case of a spill occurring on its property are discussed.

ENERGY SAFETY BRANCH
MacIver, A. I.

This presentation covered the function or role of the Energy Safety Branch, Ontario Ministry of Commercial and Consumer Relations including the Gasoline Handling Act and the Energy Act.

FFI contact Dr. N. Vanderkooy, Coordinator, Environmental Protection Service, Environment Canada, 135 St. Clair Ave. West, 2nd Floor, Toronto, Ontario M4V 1P5, Canada.

Dec. 15-17 Conference/Workshop on Baseline Research in Washington and Oregon Relative to Offshore Resource Development, Portland, Oregon, 1976.
Sponsored by the Research Triangle Institute of North Carolina and the U.S. Bureau of Land Management.

The purpose of the conference/workshop sessions was to (1) summarize available information necessary to understand the environmental processes of the Continental Shelf of the designated area; (2) provide predictions on environmental effects of OCS oil and gas development in the designated area based on available information; (3) identify areas requiring additional studies of the environmental impacts of OCS oil and gas development; and (4) formulate recommendations for a studies program that will help determine the environmental impacts of drilling in the designated OCS areas.

Oil Pollution Related Papers/Workshops

Plenary Session - December 15

FRAMEWORK FOR BUREAU OF LAND MANAGEMENT PROGRAM
Monastero, F.

FWS ACTIVITIES IN THE PACIFIC NORTHWEST
Watson, J.

NORTHWEST COASTAL RESEARCH ACTIVITIES OF ERDA
Forster, W.

NOAA/NMFS ACTIVITIES IN THE PACIFIC NORTHWEST
Hayes, M.

EPA'S ROLE, INTEREST, AND RESPONSIBILITIES WITH RESPECT TO OCS DEVELOPMENT
Baumgardner, D.

COASTAL MANAGEMENT INFORMATION NEEDS
Stang, P.

RESUME OF OFFSHORE OIL OPERATION
Scott, R.

STATE CONSIDERATIONS
Anon.

Workshop sessions held December 15-17 dealt with geological, physical, chemical, and biological oceanography considerations.

FFI contact Dr. Martin F. Massoglia, Research Triangle Institute of North Carolina, P. O. BOX 12194, Research Triangle Park, NC 27709.

1977

*Jan. 11-12 ASTM Symposium on Chemical Dispersants for the Control of Oil Spills, Dallas, Texas, 1977.

FFI contact American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

*Jan. 17-Feb. 27 Workshop on Aquatic Pollution in Relation to Protection of Living Resources, Manila, The Philippines, 1977. Sponsored by the Swedish International Development Authority (SIDA), and the Food and Agriculture Organization.

FFI contact Dr. H. Naeve, FAO Department of Fisheries, Via delle Terme di Caracalla, 00100 Rome, Italy.

Jan. 27-28 Marine Safety Seminar, Corpus Christi, Texas, 1977. Sponsored by MSAT (Marine Services Association of Texas), I.E.R.D. (Industrial Economics Research Division of Texas A & M University), and Sea Grant/Center for Marine Resources, Texas A & M University.

The purpose of the seminar is to allow industry leaders and government officials to review, discuss and evaluate marine safety programs, practices, regulations, and problems. Offshore service boats, ships, diving, shipbuilding, and offshore drilling operations are among the topics discussed.

Oil Pollution Related Discussion

Agency Panel Discussion
SAFETY REGULATIONS FOR THE MARINE/OFFSHORE INDUSTRY -- ESTABLISHMENT AND ENFORCEMENT
Alford, R., W. M. Benkert, J. M. Meagher, and R. B. Krahl

FFI contact Mr. Dewayne Hollin, Conference Coordinator, 1200 South Post Oak Rd., Suite 422, Houston, TX 77056.

*Mar. 8-10 International Symposium on Marine Pollution Research, Gulf Breeze, Florida, 1976. Sponsored by the U.S. Environmental Protection Agency, Office of International Affairs.

FFI contact D. H. Ahearn, School of Arts, Georgia State University, Atlanta, GA 30303.

*Mar. 8-10 Conference on the Prevention, Control and Cleanup of Oil Pollution, 5th, New Orleans, Louisiana, 1977. Sponsored by the American Petroleum Institute, U.S. Environmental Protection Agency, and U.S. Coast Guard.

Oil Pollution Related Papers

Session 1 - Legal Aspects

IMCO AND THE EVOLVING INTERNATIONAL SCHEME FOR CONTROLLING MARINE POLLUTION
Schubert, F. P.

INTERNATIONAL REGULATIONS OF THE TANKER INDUSTRY
Gray, W. O., C. J. Carven, and G. L. Becker

RECOVERING FOR MARINE LIFE DAMAGE: LEGAL ASPECTS OF ALLOCATING SOCIAL COSTS AND PROTECTING PUBLIC INTERESTS
Merck, J. P., and R. E. Lutz

OIL SPILL LIABILITY AND COMPENSATION--THE SUPERFUND CONCEPT
Reynolds, J. J.

Session 2 - Fast Current Equipment

DEVELOPMENT OF A HIGH CURRENT STREAMLINED OIL BOOM/ SKIMMER FOR INLAND WATERWAYS
Folsom, B. A., and C. Johnson

HYDRODYNAMICS OF A DIVERSIONARY BOOM
McCracken, W. E., and F. J. Freestone

USE OF FLOATING DEFLECTORS FOR OIL SPILL CONTROL IN FAST FLOWING WATERS
Eryuzly, N. E., and R. Hausser

PERFORMANCE TESTS OF THREE FAST CURRENT OIL RECOVERY DEVICES
Getman, J. H.

Session 3 - Weathering of Spilled Oil

FATE OF CRUDE OIL SPILLED IN A SIMULATED ARCTIC ENVIRONMENT
MacGregor, C., and A. Y. McLean

PERSISTENCE OF NON-ALKANE COMPONENTS OF BUNKER C OIL IN BEACH SEDIMENTS OF CHEDABUCTO BAY, AND LACK OF THEIR METABOLISM BY MOLLUSCS
Vandermuelen, J. H., P. D. Keizer, and W. R. Penrose

SURFACE PERSISTENCE OF CRUDE OIL SPILLED ON LAND AND ITS TRANSPORT IN GROUNDWATER
Duffy, J. J., E. Peake, and M. F. Mohtadi

THE FATE OF PETROLEUM IN A SOIL ENVIRONMENT
Creswell, L. W.

Session 4 - Chesapeake Bay Spills

ECOLOGICAL EFFECTS OF EXPERIMENTAL OIL SPILLS ON EASTERN COASTAL PLAIN ESTUARINE ECOSYSTEMS
Bender, M. E., E. A. Shearls, R. P. Ayres, C. H. Hershner, and R. J. Huggett

CHEMICAL INVESTIGATIONS OF TWO EXPERIMENTAL OIL SPILLS IN AN ESTUARINE ECOSYSTEM
Bieri, R.H., C. Stamoudis, and M. K. Cueman

THE CHESAPEAKE BAY OIL SPILL OF FEBRUARY 2, 1976 -- A CASE HISTORY
Roland, J. V., G. E. Moore, and M. A. Bellanca

EFFECTS OF THE CHESAPEAKE BAY OIL SPILL OF FEBRUARY 2, 1976 ON SALT MARSHES OF THE LOWER BAY
Hershner, C., and K. Moore

Session 5 - Spill Prevention and Cooperatives

SPILL PREVENTION AND COOPERATIVES PLANNING: GOOD MANAGEMENT PRACTICE
Clark, D. A.

PREVENTING OIL SPILLS IN THE WEST COAST FOREST INDUSTRY
Melville, L., and P. Hamm

U.S. NAVY R&D EFFORTS IN SUPPORT OF OIL POLLUTION ABATEMENT STRATEGIES
Hura, M., and S. Finger

THE STORY OF A SUCCESSFUL OIL SPILL COOPERATIVE -- THE CORPUS CHRISTI AREA OIL SPILL CONTROL ASSOCIATION
Franklin, H. L.

WHAT CONSTITUTES A GOOD TELECOMMUNICATIONS SYSTEM FOR OIL SPILL CLEANUP
Pearce, R. B.

Session 6 - Booms and Skimmers

SURFACE ENHANCEMENT - BRINGING IT ALL TOGETHER
Wilson, J. E.

FRENCH OIL SPILL POLICY- THE RECOVERY PHASE
Guerin, P., and J. Pinchon

SOCK - AN OIL SKIMMING KIT FOR VESSELS OF CONVENIENCE
Ayers, R. R.

DEVELOPMENT OF AN OIL SPILL RECOVERY SHIP
Uchida, S., H. Takeshita, and Y. Seike

COMBINED SKIMMER-BARRIER HIGH SEAS OIL RECOVERY SYSTEM
Milgram,J.H. andR. A. Griffiths

Session 7 - Dispersants

THE CONCENTRATIONS OF OIL IN SEA WATER RESULTING FROM NATURAL AND CHEMICALLY INDUCED DISPERSION OF OIL SLICKS
Cormack, D., and J. S. Nichols

NEW CONCEPT OF OIL DISPERSION IN VIEW OF CLEAN-UP BY DEGRADATION
Bocard, C., B. Durif-Varambon, C. Gatellier, P. Renault, P. Laboureur, and L. Person

SOME RECENT OBSERVATIONS REGARDING THE UNIQUE CHARACTERISTICS AND EFFECTIVENESS OF SELF-MIX CHEMICAL DISPERSANTS
Canevari, G. P.

DISPERSANT FIELD TRIALS IN CANADIAN WATERS
Gill, S.

UTILIZATION OF DISPERSANTS IN OFFSHORE AREAS
Fitzgerald, D. E.

RECOMMENDED CRITERIA FOR DISPERSANT USE
McCarthy, L. T., Jr.

TECHNIQUES FOR MIXING DISPERSANT TREATED OIL SLICKS INTO THE WATER
Smith, G. F., and W. E. McCracken

Session 8 - Monitoring Equipment

DEVELOPMENT OF AN OIL IN WATER CONTENT MONITOR
Hornig, A. W., J. T. Brownrigg, B. R. Chisholm, L. P. Giering, and R. L. Skewes

LIGHT SCATTERING TECHNIQUES FOR DISCRIMINATING BETWEEN OIL AND PARTICULATES IN CONTAMINATED WATER
Friedman, B.

DEVELOPMENT AND TEST OF A SHIPBOARD CONTINUOUS ON-LINE OIL-IN-WATER CONTENT MONITOR USING FORWARD (LASER) LIGHT SCATTERING TECHNIQUES
Batutis, E.F., and R. L. Skewes

MONITORING OIL CONTENT IN SHIPBOARD WASTE WATER DISCHARGES BY USE OF A MULTI-PHASE DYE TRANSFER PROCESS
Ricci, R.J., and A. H. Kelley

EXPERIENCE IN MONITORING THE OIL CONTENT OF BALLAST WATER BEING DISCHARGED BY TANKERS
Fleming, K. and J. P. P. Dick

QUANTIFICATION OF NAVY OILS IN DETERGENT LADEN WATERS
Yu, T. S.

Session 9 - Financial Aspects

SUMMARY OF DATA AND TECHNIQUES FOR PREDICTING OIL SPILLS
Beyer, A. H. and L. J. Painter

CONTROLLING POLLUTION OF THE MARINE ENVIRONMENT: AN ECONOMIC ANALYSIS
Epple, D., M. Visscher, W.A. Wallace, and J. W. Wilkinson

PROBLEMS AND PERSPECTIVES IN THE RECOVERY OF OIL POLLUTION REMOVAL COSTS
Johnston, H.N., Jr.

A MODEL FOR THE COSTING OF OIL SPILL CLEARANCE OPERATIONS AT SEA
Holmes, P. D.

SLIKTRAK - A COMPUTER SIMULATION OF OFFSHORE OIL SPILLS AND THEIR COST
Blaikley, D. R., G. F. L. Dietzel, A. W. Glass, and P. J. van Kleef

Session 10 - Debris, Disposal and Land Spills

EFFECTIVELY RECOVERING OIL SPILLS TO GROUNDWATER
Dennis, D. M.

DISCOVERY, CONTAINMENT AND RECOVERY OF A JET FUEL STORAGE TANK LEAK - A CASE HISTORY
Martin, C., D. Reeves, A. Tilts, and J. Bauer

PRACTICAL RECOMMENDATIONS FOR OIL SPILL DEBRIS DISPOSAL
Farlow, J. S., R. Landreth, and D. E. Ross

DEBRIS HANDLING SYSTEM FOR NAVY HARBOR OIL SPILL CLEANUP OPERATIONS
Nadeau, P. F.

BLACK OIL DISPOSAL TECHNIQUES
Wise, N. and P. A. Brunk

Session 11 - Fate and Effects (General)

RESEARCH PRIORITIES REGARDING THE FATE OF SPILLED OIL
Kolpack, R. L.

A REVIEW OF SOME COMMONLY USED PARAMETERS FOR THE DETERMINATION OF OIL POLLUTION
Gruenfeld, M., and U. Frank

PHOTO-OXIDATION OF CRUDE OILS
Nagata, S., and G. Kondo

RESPONSES OF THE CLAM *MACOMA BALTHICA* TO PRUDHOE BAY CRUDE OIL
Shaw, D. G. , A. J. Paul, and E. R. Smith

EFFECTS OF DRILL MUD ON SEDIMENT CLEARING RATES OF CERTAIN HERMATYPIC CORALS
Thompson, J. H., and T. J. Bright

THE EFFECTS OF PELAGIC HYDROCARBONS ON THE ROCKY INTERTIDAL FLORA AND FAUNA OF BERMUDA
Maynard, N. G., C. D. Gebelein, and A. Zsolnay

Session 12 - Monitoring Techniques and Applications

BIOGENIC HYDROCARBONS IN INTERTIDAL COMMUNITIES
Zsolnay, A., N. G. Maynard, and C. D. Gebelein

A LIQUID CHROMATOGRAPHIC FLUORESCENCE TECHNIQUE FOR ESTIMATING CRUDE OIL IN WATER, SEDIMENT AND BIOLOGICAL MATERIAL
Miles, D.H., M.J. Coign, and L. R. Brown

PETROLEUM AND ANTHROPOGENIC INFLUENCE ON THE COMPOSITION OF SEDIMENTS FROM THE SOUTHERN CALIFORNIA BIGHT
Reed, W. E., I. R. Kaplan, M. Sandstrom, and P. Mankiewicz

THE COAST GUARD'S FORENSIC OIL IDENTIFICATION SYSTEM
Clow, J. C.

FEASIBILITY OF CONTINUOUS MONITORING FOR OIL POLLUTION ACROSS CHANNELS AND RIVERS
Ramble, G. S. Jr., R. H. Morgan, and D. R. Jones

THE DETECTION AND MAPPING OF OIL ON A MARSHY AREA BY A REMOTE LUMINESCENT SENSOR
McFarlane, C. and R. D. Watson

Session 13 - Training

A WORKSHOP FOR DEFINING ROLE OF LOCAL GOVERNMENTS IN OIL SPILL RESPONSE
Putman, W. H.

A BAD DAY AT BUNKER POINT
Marcus, E.

HIATUSPORT - AN ON-SCENE COORDINATOR ROLE PLAYING EXERCISE
Kangster, E. B., III

CONSORTIUM ON SPILL TRAINING
Kay, G. H.

OIL SPILL CONTROL TRAINING: TEXAS A&M UNIVERSITY'S APPROACH
Payne, J. L.

THE SPILL TRAINING AND EDUCATION PROGRAM AT TEXAS A&I - CORPUS CHRISTI
Gilchrist, R. E.

Session 14 - Cold Climate

OIL SLICK SPREADING BENEATH A UNIFORM ICE COVER IN THE PRESENCE OF A CURRENT
Weiskopf, F. B., and M. S. Uzuner

DEVELOPMENT OF AN ARCTIC OIL SPILL RECOVERY SYSTEM FOR ARCTIC OPERATIONS
Scharfenstein, C. F., and M. G. Hoard

A FIELD EVALUATION OF OIL SPILL RECOVERY DEVICES
Solsberg, L. B.

THE APPLICATION OF EXISTING OIL SPILL ABATEMENT TO COLD REGIONS
Schultz, L. A., and P. C. Deslauriers

ARCTIC OFFSHORE OIL SPILL COUNTERMEASURES WITH EMPHASIS ON AN OIL AND GAS BLOWOUT IN THE SOUTHERN BEAUFORT SEA
Thornton, D. E., S. L. Ross, W. J. Logan, and C. W. Ross

UNDERWATER BLOWOUT OIL COLLECTION
Westergaard, R. H.

Session 15 - Effects on Marine Organisms

A CONTINUOUS FLOW BIOASSAY SYSTEM FOR THE EXPOSURE OF MARINE ORGANISMS TO OIL
Hyland, J. L., P. F. Rogerson, and G. R. Gardner

FLOW-THROUGH SYSTEM FOR CHRONIC EXPOSURE OF AQUATIC ORGANISMS TO SEAWATER-SOLUBLE HYDROCARBONS FROM CRUDE OIL: CONSTRUCTION AND APPLICATIONS
Roubal, W. T., D. H. Bovee, T. K. Collier, and S. I. Stranahan

EFFECTS OF A CONTINUOUS LOW-LEVEL NO. 2 FUEL DISPERSION ON LABORATORY-HELD INTERTIDAL COLONIES
Vanderhorst, J. R., R. M. Bean, L. J. Moore, P. Wilkinson, C. I. Gibson, and J. W. Blaylock

THE SUBLETHAL EFFECTS OF NATURAL CHRONIC EXPOSURE TO PETROLEUM ON MARINE INVERTEBRATES
Straughan, D.

THE EFFECTS OF CRUDE OIL ON LARVAE OF LOBSTER *HOMARUS AMERICANUS*
Forns, J. M.

SENSITIVITY OF LARVAL AND ADULT ALASKAN SHRIMP AND CRABS TO ACUTE EXPOSURES OF THE WATER-SOLUBLE FRACTION OF COOK INLET CRUDE OIL
Brodersen, C. C., S. D. Rice, J. W. Short, T. A. Mecklenburg, and J. F. Karinen

Session 16 - Surveillance/Enforcement

COMPARATIVE EVALUATION OF REAL AND SYNTHETIC APERTURE RADARS FOR THE DETECTION OF OIL POLLUTION IN THE SANTA BARBARA CHANNEL
Kraus, S. P., J. E. Estes, and R. R. Vollmers

CURRENT APPLICATIONS OF REMOTE OIL MONITORING EQUIPMENT
Wright, J. A.

SATELLITE SENTINEL FOR OIL SPILLS IN 1978?
Hovis, W. A., and D. R. Jones

U. S. COAST GUARD AIRBORNE OIL SURVEILLANCE SYSTEM STATUS REPORT
Maurer, A. T., A. T. Edgerton, and D. C. Meeks

AERIAL PHOTOGRAPHIC APPLICATIONS IN SUPPORT OF OIL SPILL CLEANUP, CONTROL, AND PREVENTION
Jones, D., R. Landers, and A. Pressman

PREVENTION OF POLLUTION DURING OIL TRANSFER OPERATIONS: AN EVALUATION OF USCG PREVENTIVE ACTIONS
Harrald, J. R., C. M. Stone, and K. R. Karwan

Session 17 - Contingency Planning I

A DYNAMIC INTERNATIONAL CONTINGENCY PLAN
Corbett, C. R., and C. J. Beckett

THE ST. LAWRENCE RIVER OIL SPILL OF 23 JUNE 1976 -- ARE YOU EVER TRULY READY?
Foley, J. P., and S. J. Tressider

OIL SPILL CONTINGENCY PLANNING FOR THE BP FORTIES OILFIELD PRODUCTION, PIPELINE AND TERMINAL SYSTEMS
Fulleylove, R. J., and T. E. Lester

THE TANKER/PIPELINE CONTROVERSY REGARDING THE MINIMAL AMOUNT OF OIL SPILLED DURING TRANSIT
Stewart, R. J.

OIL SPILL CONTROL IN ALBERTA
Bohme, V. E., and E. R. Brushett

Session 18 - Beaches, Marshes, and Sorbents

BIOLOGICAL CRITERIA FOR THE SELECTION OF CLEAN-UP TECHNIQUES IN SALT MARSHES
Westree, B.

EVALUATION OF SELECTED SURFACE TREATMENT AGENTS FOR THE PROTECTION OF SHORELINES FROM OIL SPILLS
Foget, C. R., S. Thornton, and R. Castle

HACKENSACK ESTUARY OIL SPILL: CUTTING OIL-SOAKED MARSH GRASS AS AN INNOVATIVE DAMAGE CONTROL TECHNIQUE
Mattson, C. P., N. C. Vallario, D. J. Smith, S. Anisfield, and G. Potera

A DISTRIBUTED REUSEABLE-SORBENT OIL RECOVERY SYSTEM
Shaw, S. H., and J. S. Dorrler

AN OFFSHORE MECHANIZED SORBENT OIL RECOVERY SYSTEM USING VESSELS OF OPPORTUNITY
Brunner, D. E., J. J. Der, and D. Hall

Session 19 - Organisms - Uptake/Depuration

BIOAVAILABILITY OF PETROLEUM HYDROCARBONS FROM WATER, SEDIMENTS, AND DETRITUS TO THE MARINE ANNELID, *NEANTHES ARENACEODENTATA*
Rossi, S. S.

PETROLEUM SULFUR-CONTAINING COMPOUNDS AND AROMATIC HYDROCARBONS IN THE MARINE MOLLUSKS *MODIOLUS DEMISSUS* AND *CRASSOSTREA VIRGINICA*
Lake, J. L. and C. Hershner

DISTRIBUTION OF NAPHTHALENES WITHIN EXPOSED *FUNDULUS SIMULUS* AND CORRELATIONS WITH STRESS BEHAVIOR
Dixit, D., and J. W. Anderson

THE UPTAKE OF NAPHTHALENES BY THE CLAM, *RANGIA CUNEATA*, IN THE VICINITY OF AN OIL SEPARATOR PLATFORM IN TRINITY BAY, TEXAS
Fucik, K. W., H. W. Armstrong, and J. M. Neff

MICRO-ORGANISMS AND HYDROCARBONS IN THE NORTH SEA DURING JULY-AUGUST, 1975
Oppenheimer, C. H., W. Gunkel, and G. Gassman

Session 20 - Aquatic Effects of Spilled Oil

WATER SOLUBLE COMPONENTS OF CRUDE OILS, FUEL OILS AND USED CRANKCASE OILS
Winters, K., and P. L. Parker

EXTRACTABLE ORGANICS AND NONVOLATILE HYDROCARBONS IN NEW YORK HARBOR WATERS
Searl, T. D., H. L. Huffman, Jr., and J. P. Thomas

DISTRIBUTION OF VOLATILE HYDROCARBONS IN SOME PACIFIC OCEAN WATERS
Koons, C. B.

FATE OF PETROLEUM COMPONENTS IN ESTUARINE WATERS OF THE SOUTHEASTERN UNITED STATES
Lee, R. F.

EFFECTS OF THE MARCH 18, 1973 OIL SPILL NEAR CABO ROJO, PUERTO RICO ON TROPICAL MARINE COMMUNITIES
Nadeau, R. J., and E. T. Bergquist

OIL POLLUTION AND TROPICAL LITTORAL COMMUNITIES: BIOLOGICAL EFFECTS OF THE 1975 FLORIDA KEYS OIL SPILL
Chan, E. I.

Session 21 - Contingency Planning II

TECHNICAL SUPPORT OF SPILL CONTROL OPERATIONS
Marum, J. P., W. R. Quanstrom, and R. G. Will

THE DEVELOPMENT AND USE OF RESOURCE SENSITIVITY MAPS FOR OIL SPILL COUNTERMEASURES
Hum, S.

OIL SPILL RESPONSE PLANNING FOR BIOLOGICALLY SENSITIVE AREAS
Lidstedt-Siva, J.

CONTINGENCY PLANNING FOR THE IMPACT OF OIL SPILLS IN DIFFERENT COASTAL ENVIRONMENTS OF EASTERN CANADA
Owens, E. H.

Session 22 - Pollution Control Technology

CLEANING AGENTS FOR OILED WILDLIFE
Berkner, A. B., D. C. Smith, and A. S. Williams

NEW TEST FACILITIES FOR THE PREVENTION OF OIL POLLUTION IN JAPAN
Yazaki, A.

NAVY DEVELOPMENT OF SUITABLE SHIPBOARD BILGE OIL/WATER SEPARATORS
Smookler, A. L., J. W. Harden, Jr., and P. D. Conroy

FAST SURFACE DELIVERY SYSTEM FOR POLLUTION RESPONSE EQUIPMENT
Larrabee, R. M., and R. Ward

Session 23 - Notable Oil Spills

SOME STUDIES OF AN OIL SPILLAGE DUE TO THE "JACOB MAERSK" ACCIDENT
Canelas, L. D., and J. D. Calejo Monteiro

SINKING OF TANKER ST. PETER OFF COLUMBIA
Hayes, T. M.

THE FIVE-YEAR RECRUITMENT OF MARINE LIFE AFTER THE 1971 SAN FRANCISCO OIL SPILL
Chan, G. L.

FATE OF OIL FROM THE SUPERTANKER "METULA"
Hann, R. W., Jr.

Session 24 - Spill Modeling

A COMPUTER SIMULATION TECHNIQUE FOR OIL SPILLS OFF THE NEW JERSEY - DELAWARE COASTLINE
Lissauer, I. M., J. C. Bacon, and M. C. Miller

NEW YORK HARBOR OIL DRIFT PREDICTION MODEL
Kollmeyer, R. C., and M. E. Thompson

THE USE OF A DIAGNOSTIC CIRCULATION MODEL FOR OIL TRAJECTORY ANALYSIS
Galt, J. A., and C. H. Pease

STORM RELATED OIL SPILL MOVEMENT ON THE BEAUFORT SEA SHELF
Hufford, G. L., I. M. Lissauer, and B. D. Thompson

FFI contact Dr. Charles C. Bates, Program Chairman, 1977 Oil Spill Conference, U. S. Coast Guard, Washington, DC 20590.

Master List of Keywords

S: See
SA: See also

Absorption
Activated sludge
Acute effects
Adriatic Sea
Adsorption
Aegean Sea
Africa
Alaska
Alaska coast
Alaska, Gulf of
Algae ... SA: Phytoplankton
Analytical techniques ...
  SA: Chemical analysis; Source
  identification
Annelids ... SA: Polychaetes
Antarctica
Arabian Sea
Arctic
Arctic Ocean
Argentina
Aromatic hydrocarbons ...
  SA: Hydrocarbons
Asia
Atlantic coast
Atlantic Ocean
Australia
Bacteria
Bahamas
Ballast
Baltic Sea
Bantry Bay
Beaches
Beaufort Sea
Behavior
Belgium
Bengal, Bay of
Benthos
Bering Sea
Bermuda coast
Bibliographies
Bilges
Biodegradation
Biological effect ... SA:
  Toxicity; Acute effects;
  Chronic effects
Biomass
Birds
Biscay, Bay of
Black Sea
Blowout prevention
Booms
Brazil
California ... SA: Southern California
California coast
Canada
Carcinogens ... SA: Health hazards;
  Aromatic hydrocarbons
Caribbean Sea
Caspian Sea
Chedabucto Bay
Chemical analysis ... SA: Analytical
  techniques; Source identification
Chemical effects
Chesapeake Bay
Chile
China
Chromatography
Chronic effect
Cleanup ... SA: Recovery; Containment
Coagulation
Coalescence
Coasts
Connecticut
Conservation
Containment
Contaminants
Contamination
Contingency planning
Coral reefs
Crankcase oil
Crude oil
Crustaceans
Decomposition
Delaware
Delaware Bay
Denmark
Design and engineering
Detection ... SA: Monitoring;
  Chemical analysis
Development ... SA: Offshore
  development; Oil shale development
Dispersants

Dispersion
Disposal ... SA: Waste oil disposal; Wastewater disposal
Distillation
Distribution
Drift ... SA: Movement; Spreading
Drilling ... SA: Offshore drilling; Oil wells
East China Sea
Echinoderms
Economic effects
Economics
Ecosystems
Ecuador
Effluent treatment ... S: Wastewater treatment
EIS
Emulsification
Emulsifiers
Emulsions
Engineering ... S: Design and engineering
England
English Channel
Environmental deterioration
Environmental effects
Environmental Impact Statements .. S: EIS
Environmental management
Environmental protection
Estuaries
Europe
Evaporation
Exploration .. SA: Offshore exploration; Production
Extraction
Fate
Filtration ... SA: Flocculation
Finland
Fishes
Fisheries
Flocculation ... SA: Filtration
Florida
Florida coast
Flotation
Food web
Foreign governments
Fossil fuels
France
Freshwater
Fuel oil
Fuels
Fungi
Gas, liquid chromatography ... S: Chromatography
Gasoline
Georgia
Germany, East
Germany, West
Gibraltar, Strait of
Government agencies ... SA: U.S. Government, State governments
Great Lakes
Groundwater
Guidelines ... SA: Manuals
Habitat
Harbors
Health hazards ... SA: Carcinogens
Hydrocarbons ... SA: Aromatic hydrocarbons; Crude oil, PAH
Incineration
India
Indian Ocean
Indonesia
Industries ... SA: Petroleum industry
Information systems
Infrared spectroscopy ... S: Spectroscopy
Inland
Insurance
International agreements
International conventions ... SA: Regulations; Legislation
Intertidal zone
Invertebrates
Iran
Iraq
Ireland
Israel
Italy
Japan
Japan, Sea of
Korea
Kuwait
Labrador Sea
Lakes ... SA: Great Lakes
Latin America
Law enforcement
Leakage
Legislation ... SA: Regulations; International conventions

Liability
Louisiana
Lubricating oil
Magellan, Strait of
Maine
Manuals ... SA: Guidelines
Marine mammals
Marine organisms
Maryland
Massachusetts
Mass spectroscopy ... S: Spectroscopy
Mediterranean Sea
Metabolism
Metula Oil Spill
Mexico
Mexico, Gulf of
Microorganisms ... SA: Algae; Bacteria; Fungi; Yeasts
Middle East
Mississippi River
Models
Mollusks
Monitoring ... SA: Detection; Remote sensing; Sampling
Movement ... SA: Spreading; Drift
Narraganset Bay
Natural seepage
Netherlands
Neuston
New Hampshire
New Jersey
New York
Niche
North Carolina
North Sea
North Vietnam
Norway
Norwegian Sea
Oceans
OCS
Offshore development .. SA: Offshore drilling, exploration, production
Offshore drilling .. SA: Offshore development, exploration, production
Offshore exploration ... SA: Offshore drilling, development
Offshore pipelines ... SA: Oil transport, pipelines
Offshore production ... SA: Offshore development, drilling
Ohio
Oil ... S: Crude oil; Fuel oil; Lubricating oil, Crankcase oil; Waste oil
Oil discharges
Oil fields ... SA: Production
Oil-gas leasing
Oil industry
Oil shale development
Oil slicks
Oil spills
Oil tanks
Oil transfer
Oil transport
Oil-water separation ... SA: Wastewater treatment
Oil wells ... SA: Drilling; Production; Offshore drilling; Offshore production
Okhotsk, Sea of
Oregon
Outer Continental Shelf ... S: OCS
Oxidation ... SA: Biodegradation; Weathering
Pacific Ocean
PAH
Personnel training
Petroleum ... S: Crude oil
Petrochemicals
Petroleum industry ... S: Oil industry
pH control
Philippines
Physical effects
Phytoplankton
Pipelines ... SA: Offshore pipelines
Plankton ... SA: Phytoplankton; Zooplankton
Plants
Pollution control
Pollution prevention ... SA: Environmental protection; Contingency planning
Polychaetes
Ports
Precipitation
Production ... SA: Offshore production; Drilling; Offshore drilling

Prudhoe Bay
Puerto Rico
Puget Sound
Reclamation ... SA: Recycling;
  Reuse
Recovery ... SA: Cleanup
Recycling ... SA: Reclamation;
  Reuse
Red Sea
Refineries
Refining
Regulations ... SA: Legislation;
  International conventions
Remote Sensing ... SA: Monitoring;
  Detection
Resource management
Restoration
Reuse ... SA: Reclamation;
  Recycling
Rhine River
Rhode Island
Rivers
Ross Sea
Safety
Sampling ... SA: Monitoring;
  Detection
San Francisco Bay
Santa Barbara Channel
Sargasso Sea
Saudi Arabia
Scotland
Seawater
Sedimentation
Sediments
Segregated ballast
Ships ... SA: Tankers
Shorelines
Sinking agents
Skimmers
Sludge
Social effects
Socio-economic effects
Soil
Solid waste
Solubility
Solution
Solvents
Source identification
South Carolina
South China Sea
Southern California ... SA:
  California
Spain
Spectrometry
Spectroscopy
Spreading ... SA: Movement, Drift
St. Lawrence River
Standing Crop
State Governments ... SA: U.S.
  Government; Government agencies
Statistical analysis
Statistics
Storage
Streams
Superports ... S: Ports
Supertankers ... S: Tankers
Surfactants
Sweden
Syria
Tankers ... SA: Ships
Tar
Tar sands
Texas
Torrey Canyon
Toxicity ... SA: Biological effects
Turkey
UK
United Kingdom ... S: UK
United States ... S: U.S.
U.S.
U.S. Government ... SA: State
  government; Government agencies
USSR
Venezuela
Vietnam
Virginia
Virgin Islands
Wales
Washington
Waste oil ... SA: Waste oil disposal,
  waste oil treatment
Waste oil disposal ... SA: Disposal
Waste oil treatment
Wastewaters ... SA: Wastewater
  disposal, wastewater treatment
Wastewater disposal ... SA: Disposal
Wastewater treatment
Water quality

Weathering
Weddell Sea
West Indies
Wildlife
Yeasts
Yugoslavia
Zooplankton

SUBJECT INDEX

THE SUBJECT INDEX IS A PERMUTED INDEX THAT LISTS ALPHABETICALLY THE KEYWORDS AND CORRESPONDING CITATION NUMBER ASSIGNED TO EACH ABSTRACT IN SECTION I (EACH INDEX NUMBER APPEARS IN SECTION I IN THE FORM (I-____-77). KEYWORDS WHICH ARE NOT INCLUDED IN THE MASTER LIST ARE PRECEDED BY A "*" AND ARE NOT LISTED IN ALPHABETICAL ORDER IN THE SUBJECT INDEX.

0102 ABSORPTION, CLEANUP, RECOVERY, OIL SPILLS,
0115 ABSORPTION, HYDROCARBONS, RECOVERY, OIL-WATER SEPARATION, *OLEOPHILIC MATERIAL,
0020 ACUTE EFFECTS, OIL SPILLS, TANKERS, CLEANUP, DISPERSANTS, MARINE ORGANISMS, *SPAIN, *URQUIOLA OIL SPILL,
0263 ACUTE EFFECTS, CHRONIC EFFECTS, OIL SPILLS, PETROLEUM PRODUCTS, REFINERIES, MARINE ORGANISMS, MONITORING,
0272 ACUTE EFFECTS, CHRONIC EFFECTS, OIL SPILLS, BIRDS, POLLUTION PREVENTION, CONSERVATION,
0276 ACUTE EFFECTS, TOXICITY, CHRONIC EFFECTS, CRUDE OIL, FUEL OIL, METABOLISM, CRUSTACEANS, *MUD CRAB,
0280 ACUTE EFFECTS, OIL SPILLS, DISPERSANTS, TOXICITY, CHRONIC EFFECTS, MARINE ORGANISMS,
0288 ACUTE EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS,
0058 ADRIATIC SEA, SAMPLING, MOLLUSKS, HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, *MUSSELS, *GULF OF VENICE,
0115 ADSORPTION, OIL SPILLS, CLEANUP, RECOVERY, *POLYETHYLENE FOAM,
0163 ADSORPTION, WASTEWATER TREATMENT, PETROCHEMICALS, OIL INDUSTRY, OIL-WATER SEPARATION, OXIDATION, INCINERATION, FLOTATION, FILTRATION,
0178 ADSORPTION, WASTEWATER TREATMENT, REFINERIES,
0181 ADSORPTION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0182 ADSORPTION, WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION, FLOCCULATION,
0201 ADSORPTION, OIL-WATER SEPARATION, PETROLEUM PRODUCTS, *SKIMMING,
0380 ADSORPTION, SEDIMENTATION, HYDROCARBONS, OIL SLICKS, EVAPORATION, *SUBTIDAL ENVIRONMENTS,
0416 ADSORPTION, HYDROCARBONS, OFFSHORE DRILLING, OIL TRANSPORT, *PARTICULATE MATTER,
0567 ADSORPTION, BIBLIOGRAPHIES, OIL SPILLS, CLEANUP, RECOVERY, OIL-WATER SEPARATION, SKIMMERS, DISPERSANTS, FLOTATION,
0228 ALASKA, CONTINGENCY PLANNING, OIL SPILLS, PIPELINES, CLEANUP, RESTORATION,
0277 ALASKA, CONTAMINATION, OIL SPILLS, CHRONIC EFFECTS, ECOSYSTEMS, EIS, PIPELINES,
0336 ALASKA, ECONOMIC EFFECTS, GUIDELINES, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, MEXICO/GULF OF, CALIFORNIA,
0338 ALASKA, OIL INDUSTRY, PRODUCTION, ECONOMIC EFFECTS,
0355 ALASKA, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, U.S. GOVERNMENT,
0361 ALASKA, HYDROCARBONS, MARINE ORGANISMS, SEDIMENTS, COASTS, PRUDHOE BAY,
0364 ALASKA/GULF OF, ENVIRONMENTAL EFFECTS, *ONSHORE EFFECTS, OFFSHORE PRODUCTION, OCS, ATLANTIC COAST,
0406 ALASKA/GULF OF, OFFSHORE DEVELOPMENT, FATE, CONTAMINATION, *SEISMICITY, *GROUND SHAKING,
0055 ALGAE, HYDROCARBONS, SAN FRANCISCO BAY, CARCINOGENS, PAH, ESTUARIES, FOOD WEB, CALIFORNIA,
0285 ALGAE, BIOLOGICAL EFFECTS, HYDROCARBONS, FISHES, INVERTEBRATES, *PHYSIOLOGICAL EFFECTS, *BIOCHEMICAL EFFECTS,
0295 ALGAE, OIL SPILLS, BIOLOGICAL EFFECTS, BACTERIA, FRESHWATER, CANADA,
0301 ALGAE, FATE, CRUDE OIL, PAH, HYDROCARBONS, SEDIMENTS, ESTUARIES, ENGLAND, *DIATOMS,
0302 ALGAE, BIOLOGICAL EFFECTS, CRUDE OIL, HYDROCARBONS, *NAPHTHALENE, *ALGAL PHYSIOLOGY,
0028 ANALYTICAL TECHNIQUES, MONITORING, SAMPLING, OIL SLICKS, TAR, SEDIMENTS, MARINE ORGANISMS, SEAWATER,
0032 ANALYTICAL TECHNIQUES, MONITORING, SOURCE IDENTIFICATION, OIL SPILLS, *LUMINESCENCE METHODS,
0046 ANALYTICAL TECHNIQUES, REMOTE SENSING, OIL SLICKS, SPREADING, *MICROWAVE RADIOMETRY, *IR RADIOMETRY,
0050 ANALYTICAL TECHNIQUES, SAMPLING, OIL SLICKS, CHROMATOGRAPHY, SPECTROMETRY,
0051 ANALYTICAL TECHNIQUES, OIL SPILLS, HYDROCARBONS, CHROMATOGRAPHY, *LUMINESCENCE,
0062 ANALYTICAL TECHNIQUES, HYDROCARBONS, SPECTROSCOPY, MICROORGANISMS, ESTUARIES, NORTH CAROLINA,
0063 ANALYTICAL TECHNIQUES, MONITORING, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0068 ANALYTICAL TECHNIQUES, HYDROCARBONS, SEAWATER, SPECTROSCOPY, REFINERIES, CANADA, ENVIRONMENTAL EFFECTS, *COME-BY-CHANCE BAY,
0070 ANALYTICAL TECHNIQUES, OIL SPILLS, SEAWATER, CALIFORNIA, *LUMINESCENCE SIGNATURES, *LOS ANGELES HARBOR,
0071 ANALYTICAL TECHNIQUES, SOLUBILITY, AROMATIC HYDROCARBONS, *POLYTHERMIC METHOD,
0072 ANALYTICAL TECHNIQUES, OIL SPILLS, SOURCE IDENTIFICATION, *SOLVENT COMPENSATION,
0076 ANALYTICAL TECHNIQUES, CRUDE OIL, SPECTROSCOPY, CHROMATOGRAPHY, SOURCE IDENTIFICATION, *LUMINESCENCE
0077 ANALYTICAL TECHNIQUES, CONTAMINANTS, HYDROCARBONS, *AIR QUALITY, WATER QUALITY,

0080 ANALYTICAL TECHNIQUES, OIL SPILLS, SAMPLING, *FLUORESCENCE, *HYDROGEN EXTRACTION,
    SOURCE IDENTIFICATION,
0261 ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, MONITORING, REMOTE SENSING,
0081 ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, *LUMINESCENCE, CRUDE OIL,
    LUBRICATING OILS,
0083 ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, *PHOSPHORESCENCE,
0087 ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, *FLUORESCENCE SPECTRA,
0188 ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, BILGES, EMULSIONS, SPECTROSCOPY, FUEL
    OILS, LUBRICATING OILS,
0316 ANALYTICAL TECHNIQUES, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, MARINE ORGANISMS,
    OIL SPILLS, CRUDE OIL, FATE, OCEANS,
0389 ANALYTICAL TECHNIQUES, BIODEGRADATION, CRUDE OIL, HYDROCARBONS, SPECTROMETRY,
0052 ARCTIC, CONTAINMENT, FUELS, PETROLEUM PRODUCTS, STORAGE, *SPILL CONTAINMENT DIKES,
0268 ARCTIC, OIL SPILLS, CLEANUP, POLLUTION CONTROL, BEAUFORT SEA,
0291 ARCTIC, TOXICITY, CRUDE OIL, MARINE ORGANISMS, INVERTEBRATES, METABOLISM,
0312 ARCTIC, WATER QUALITY, OIL SPILLS, ENVIRONMENTAL EFFECTS, CANADA,
0309 ARCTIC, FATE, CRUDE OIL, DECOMPOSITION, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS,
0071 AROMATIC HYDROCARBONS, ANALYTICAL TECHNIQUES, SOLUBILITY, *POLYTHERMIC METHOD,
0361 AROMATIC HYDROCARBONS, BIODEGRADATION, FATE, MICROORGANISMS, SOIL, *WATERS,
0002 ATLANTIC COAST, OFFSHORE DRILLING, OCS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
0230 ATLANTIC COAST, CONTINGENCY PLANNING, OIL SPILLS, OFFSHORE DRILLING, OCS, OIL
    TRANSPORT, *[illegible], *[illegible],
0311 ATLANTIC COAST, OIL SPILLS, ENVIRONMENTAL EFFECTS, HEALTH HAZARDS, AROMATIC
    HYDROCARBONS, OFFSHORE EXPLORATION, *NEW ENGLAND,
0366 ATLANTIC COAST, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, GOVERNMENT AGENCIES,
    *[illegible]
0367 ATLANTIC COAST, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, GOVERNMENT AGENCIES,
    *[illegible]
0365 ATLANTIC COAST, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, GOVERNMENT AGENCIES,
    *[illegible] MANAGEMENT,
0363 ATLANTIC COAST, OFFSHORE DEVELOPMENT, OCS, *ONSHORE IMPACTS, ENVIRONMENTAL EFFECTS,
    SOCIO-ECONOMIC EFFECTS,
0364 ATLANTIC COAST, ALASKA, GULF OF, ENVIRONMENTAL EFFECTS, *ONSHORE EFFECTS, OFFSHORE
    PRODUCTION,
0387 ATLANTIC OCEAN, BIODEGRADATION, HYDROCARBONS, BACTERIA, SEDIMENTS, SEAWATER,
0187 AUSTRALIA, REFINERIES, WASTEWATER TREATMENT, PETROCHEMICALS, OIL SPILLS, CONSERVATION,
0263 AUSTRALIA, POLLUTION PREVENTION, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING,
0308 AUSTRALIA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, SAFETY, OFFSHORE PRODUCTION,
0043 BACTERIA, MONITORING, HYDROCARBONS, BALTIC SEA, CRUSTACEANS, FISHES, BIODEGRADATION,
0296 BACTERIA, ALGAE, OIL SPILLS, BIOLOGICAL EFFECTS, FRESHWATER, CANADA,
0377 BACTERIA, BIODEGRADATION, CRUDE OIL, MICROORGANISMS, CLEANUP, MONITORING, OIL SPILLS,
0380 BACTERIA, BIODEGRADATION, HYDROCARBONS, METABOLISM, *PHOSPHORUS REQUIREMENTS,
0382 BACTERIA, BIODEGRADATION, CRUDE OIL, PETROCHEMICALS,
[illegible] BACTERIA, BIODEGRADATION, METABOLISM, SOIL, FUEL OIL, CRANKCASE OIL, CRUDE OIL,
[illegible] BACTERIA, BIODEGRADATION, [illegible], OCTANE, REFINERIES,
0387 BACTERIA, ATLANTIC OCEAN, BIODEGRADATION, HYDROCARBONS, SEDIMENTS, SEAWATER,
[illegible] BACTERIA, BIODEGRADATION, CONTAMINANTS, METABOLISM, HARBORS, CHESAPEAKE BAY, *MERCURY
    [illegible]
0026 BALLAST, MONITORING, HYDROCARBONS, BILGES, DESIGN-ENGINEERING, *FLUORESCENCE,
    *OIL-IN-WATER,
0125 BALLAST, TANKERS, CONTAMINATION, OIL TRANSPORT, OIL DISCHARGES, POLLUTION CONTROL,
    REGULATIONS,
0166 BALLAST, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE, WASTEWATER DISPOSAL,
    BILGES,
0174 BALLAST, WASTEWATER TREATMENT, SHIPS, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0175 BALLAST, WASTEWATER TREATMENT, WASTE OIL TREATMENT, TANKERS, BIODEGRADATION,
0204 BALLAST, BIODEGRADATION, OIL SPILLS, CLEANUP, BILGES, OIL TANKS, WASTEWATER TREATMENT,
    RECLAMATION, PETROLEUM PRODUCTS,
0030 BALTIC SEA, MONITORING, HYDROCARBONS, DETECTION, MOLLUSKS, *BLUE MUSSEL, *KIEL BIGHT,
0043 BALTIC SEA, BACTERIA, MONITORING, HYDROCARBONS, CRUSTACEANS, FISHES, BIODEGRADATION,
0266 BALTIC SEA, REMOTE SENSING, OIL SPILLS, *MULTISENSOR TECHNIQUE,
0833 BALTIC SEA, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, ENVIRONMENTAL PROTECTION,
    [illegible]
0057 BANTRY BAY, [illegible], OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING, IRELAND,
[illegible] BEACHES, OIL SPILLS, [illegible], TANKERS, MAGELLAN STRAIT OF,
[illegible] BEACHES, CONTAMINATION, WASTE OIL, *SEWAGE, NEW YORK,
[illegible] BEACHES, OIL SPILLS, FUEL OIL, CHESAPEAKE BAY, BIRDS, MARINE ORGANISMS, *OIL BARGE,
[illegible] BEACHES, MONITORING, HYDROCARBONS, NEW JERSEY,
[illegible] BEACHES, MONITORING, HYDROCARBONS, MEXICO, GULF OF, CHEMICAL ANALYSIS,
[illegible] BEACHES, OIL SPILLS, CRUDE OIL, TANKERS, JAPAN, *NIIGATA COAST,
[illegible] BEACHES, BIODEGRADATION, CRUDE OIL, OXIDATION, MICROORGANISMS, MONITORING,
[illegible] BEACHES, FATE, OIL SPILLS, WEATHERING, SEDIMENTS, CANADA, *NOVA SCOTIA,
[illegible] BEACHES, CONTAMINATION, CONTAMINANTS, SEDIMENTS, CANADA, *NOVA SCOTIA, *HALIFAX HARBOUR,
[illegible] BEACHES, CRUDE OIL, FATE, CHEMICAL ANALYSIS, CHROMATOGRAPHY, COASTS, INDIA, *TAR BALLS,
0373 BEACHES, FATE, FUEL OIL, CHEDABUCTO BAY, CANADA, SEDIMENTS, *WATER COLUMN, MARINE

ORGANISMS, CHRONIC EFFECTS.

0231 BEAUFORT SEA, CONTINGENCY PLANNING, OIL SPILLS, CANADA, GOVERNMENT AGENCIES, OIL INDUSTRY.

0248 BEAUFORT SEA, ARCTIC, OIL SPILLS, CLEANUP, POLLUTION CONTROL.

0249 BEAUFORT SEA, BLOWOUT PREVENTION, DRILLING, OIL SPILLS, CLEANUP, BOOMS, SKIMMERS, CONTINGENCY PLANNING.

0250 BEAUFORT SEA, DRILLING, OIL SPILLS, MOVEMENT, CANADA, *OIL-ON-ICE.

0316 BEHAVIOR, BIOLOGICAL EFFECTS, OIL SPILLS, NORTH SEA, FATE, CLEANUP.

0367 BEHAVIOR, OFFSHORE PRODUCTION, NORTH SEA, OIL SPILLS, BIOLOGICAL EFFECTS, MONITORING, POLLUTION CONTROL.

0391 BEHAVIOR, OIL SPILLS, *FREEZING CONDITIONS, EVAPORATION, BIOLOGICAL EFFECTS, MARINE ORGANISMS.

0392 BEHAVIOR, BEACHES, FATE, OIL SPILLS, SEDIMENTS, CANADA, *NOVA SCOTIA.

0395 BEHAVIOR, OIL SLICKS, WEATHERING, SPREADING, EVAPORATION, TAR.

0155 BELGIUM, REFINERIES, WASTEWATERS, POLLUTION CONTROL.

0260 BENTHOS, BIOLOGICAL EFFECTS, HYDROCARBONS, PHYTOPLANKTON, ZOOPLANKTON, WATER QUALITY, GASOLINE, *MARINE ENGINE EMISSIONS.

0326 BERMUDA COAST, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, MARINE ORGANISMS, MEXICO/GULF OF, VENEZUELA, NATURAL SEEPAGE, SANTA BARBARA CHANNEL, TAR.

0120 BIBLIOGRAPHIES, OIL SPILLS, DISPERSANTS, TOXICITY, REGULATIONS, CANADA.

0297 BIBLIOGRAPHIES, OCS, OFFSHORE DEVELOPMENT, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, ENVIRONMENTAL MANAGEMENT.

0386 BIBLIOGRAPHIES, BIODEGRADATION, HYDROCARBONS, METABOLISM, MICROORGANISMS, FUNGI.

0515 BIBLIOGRAPHIES, FATE, OIL SPILLS, OCEANS, *PHYSICAL CHANGES, *CHEMICAL CHANGES.

0636 BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, OIL SPILLS, PETROCHEMICALS, MARINE ORGANISMS, PUGET SOUND.

0639 BIBLIOGRAPHIES, WASTEWATER TREATMENT, INDUSTRIES, PETROCHEMICALS, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS.

0640 BIBLIOGRAPHIES, OFFSHORE DRILLING, INSURANCE, LIABILITY, *OIL RIG INSURANCE.

0641 BIBLIOGRAPHIES, OIL SPILLS, ENVIRONMENTAL EFFECTS.

0642 BIBLIOGRAPHIES, OFFSHORE DRILLING, OIL WELLS, ENVIRONMENTAL EFFECTS.

0643 BIBLIOGRAPHIES, TANKERS, PORTS, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS.

0644 BIBLIOGRAPHIES, TANKERS, PORTS, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS.

0645 BIBLIOGRAPHIES, OIL SPILLS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, TOXICITY, MARINE ORGANISMS.

0646 BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, BIODEGRADATION, *TROPICAL WATERS.

0647 BIBLIOGRAPHIES, ADSORPTION, OIL SPILLS, CLEANUP, RECOVERY, OIL-WATER SEPARATION, SKIMMERS, DISPERSANTS, FLOTATION.

0648 BIBLIOGRAPHIES, WASTEWATER TREATMENT, INDUSTRIES, PETROCHEMICALS, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS.

0008 BILGES, OIL SLICKS, ESTUARIES, UK, SHIPS, SOURCE IDENTIFICATION.

0024 BILGES, BALLAST, MONITORING, HYDROCARBONS, DESIGN-ENGINEERING, *FLUORESCENCE, *OIL-IN-WATER.

0138 BILGES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, TANKERS, JAPAN.

0156 BILGES, BALLAST, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE, WASTEWATER DISPOSAL.

0171 BILGES, OIL-WATER SEPARATION, SHIPS, WASTEWATER TREATMENT.

0175 BILGES, OIL-WATER SEPARATION, WASTE OIL, DESIGN-ENGINEERING.

0188 BILGES, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, EMULSIONS, SPECTROSCOPY, FUEL OIL, LUBRICATING OIL.

0200 BILGES, TANKERS, WASTEWATER TREATMENT, *CHARACTERIZATION STUDIES, FUELS.

0376 BILGES, BALLAST, BIODEGRADATION, OIL SPILLS, CLEANUP, OIL TANKS, WASTEWATER TREATMENT, RECLAMATION, PETROLEUM PRODUCTS.

0063 BIODEGRADATION, BALTIC SEA, BACTERIA, MONITORING, HYDROCARBONS, CRUSTACEANS, FISHES.

0170 BIODEGRADATION, BALLAST, WASTEWATER TREATMENT, WASTE OIL TREATMENT, TANKERS.

0324 BIODEGRADATION, HYDROCARBONS, TOXICITY, WATER QUALITY, ESTUARIES, FRESHWATER, SEAWATER, *U.S. EPA.

0325 BIODEGRADATION, ENVIRONMENTAL EFFECTS, FUEL OIL, OIL SPILLS, SHORELINES, MARINE ORGANISMS, CANADA, CHEDABUCTO BAY.

0335 BIODEGRADATION, ECONOMICS, MODELS, REFINERIES, OIL SPILLS, CALIFORNIA, *CRUDE OIL COSTS.

0374 BIODEGRADATION, METABOLISM, HYDROCARBONS, FUNGI, YEASTS.

0375 BIODEGRADATION, OIL SPILLS, MICROORGANISMS, CLEANUP, *NUTRIENT ADDITION.

0376 BIODEGRADATION, BILGES, BALLAST, OIL SPILLS, CLEANUP, OIL TANKS, WASTEWATER TREATMENT, RECLAMATION, PETROLEUM PRODUCTS.

0377 BIODEGRADATION, BACTERIA, CRUDE OIL, MICROORGANISMS, CLEANUP, MONITORING, OIL SPILLS.

0378 BIODEGRADATION, BEACHES, CRUDE OIL, OXIDATION, MICROORGANISMS, MONITORING.

0379 BIODEGRADATION, DECOMPOSITION, CRUDE OIL, MICROORGANISMS, *MINERAL OIL.

0380 BIODEGRADATION, BACTERIA, HYDROCARBONS, METABOLISM, *PHOSPHORUS REQUIREMENTS.

0381 BIODEGRADATION, AROMATIC HYDROCARBONS, TAR, MICROORGANISMS, SOIL, *WATERS.

0382 BIODEGRADATION, BACTERIA, CRUDE OIL, PETROCHEMICALS.

0383 BIODEGRADATION, HYDROCARBONS, MICROORGANISMS, OIL SPILLS, *CELLULOSIC SUBSTRATES.

0385 BIODEGRADATION, BACTERIA, METABOLISM, SOIL, FUEL OIL, CRANKCASE OIL, CRUDE OIL.

0386 BIODEGRADATION, BIBLIOGRAPHIES, HYDROCARBONS, METABOLISM, MICROORGANISMS, FUNGI.

0386 BIODEGRADATION, BACTERIA, HYDROCARBONS, OCEANS, REFINERIES,
0387 BIODEGRADATION, BACTERIA, ATLANTIC OCEAN, HYDROCARBONS, SEDIMENTS, SEAWATER,
0388 BIODEGRADATION, BACTERIA, CONTAMINANTS, METABOLISM, HARBORS, CHESAPEAKE BAY, *MERCURY
INHIBITION,
0389 BIODEGRADATION, ANALYTICAL TECHNIQUES, CRUDE OIL, HYDROCARBONS, SPECTROSCOPY,
0401 BIODEGRADATION, MOVEMENT, FATE, HYDROCARBONS, MARINE ORGANISMS, *CHEMORECEPTION,
0403 BIODEGRADATION, FATE, CRUDE OIL, OCEANS, EVAPORATION, WEATHERING,
0446 BIODEGRADATION, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS,
MARINE ORGANISMS, *TROPICAL WATERS,
0017 BIOLOGICAL EFFECTS, HYDROCARBONS, FATE, ENVIRONMENTAL EFFECTS, *SYMPOSIUM,
0023 BIOLOGICAL EFFECTS, OIL SPILLS, CONTAMINATION, JAPAN, LEGISLATION, POLLUTION
PREVENTION,
0257 BIOLOGICAL EFFECTS, HYDROCARBONS, MARINE ORGANISMS,
0260 BIOLOGICAL EFFECTS, BIRDS, OFFSHORE DEVELOPMENT, FISHERIES, SCOTLAND, *CONFERENCE,
0261 BIOLOGICAL EFFECTS, DISPERSANTS, CRUDE OIL, TOXICITY, MOLLUSKS, *RESPIRATION RATE,
0262 BIOLOGICAL EFFECTS, CONTAMINATION, SEDIMENTS, *CORALS,
0264 BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, LAKES, VENEZUELA, *LAKE MARACAIBO,
0265 BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, FATE, FISHERIES, LAKES, VENEZUELA,
ECONOMICS, *LAKE MARACAIBO,
0268 BIOLOGICAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, MASSACHUSETTS, *WEST FALMOUTH SPILL,
0269 BIOLOGICAL EFFECTS, BENTHOS, HYDROCARBONS, PHYTOPLANKTON, ZOOPLANKTON, WATER QUALITY,
GASOLINE, *MARINE ENGINE EMISSIONS,
0270 BIOLOGICAL EFFECTS, FUEL OIL, OIL SPILLS, BIRDS, SCOTLAND, POLLUTION CONTROL, *RIVER
YTHAN,
0271 BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, CANADA, *BAY OF FUNDY, CHRONIC EFFECTS,
0272 BIOLOGICAL EFFECTS, OIL SPILLS, PETROCHEMICALS, MARINE ORGANISMS, PUGET SOUND,
*LITERATURE REVIEW,
0273 BIOLOGICAL EFFECTS, HYDROCARBONS, ZOOPLANKTON, TOXICITY, METABOLISM,
0275 BIOLOGICAL EFFECTS, TAR, MARINE ORGANISMS, ECHINODERMS, *EGG DEVELOPMENT,
0278 BIOLOGICAL EFFECTS, CONTAMINATION, CRUDE OIL, MARINE MAMMALS, *RINGED SEALS, OFFSHORE
DEVELOPMENT,
0279 BIOLOGICAL EFFECTS, OIL SPILLS, FUEL OIL, METABOLISM, MOLLUSKS, *MYA ARENARIA, *CARBON
FLUX,
0283 BIOLOGICAL EFFECTS, CRUDE OIL, TOXICITY, EMULSIFIERS, FISHES,
0285 BIOLOGICAL EFFECTS, ALGAE, HYDROCARBONS, FISHES, INVERTEBRATES, *PHYSIOLOGICAL
EFFECTS, *BIOCHEMICAL EFFECTS,
0286 BIOLOGICAL EFFECTS, MODELS, OIL SPILLS, MARINE ORGANISMS,
0287 BIOLOGICAL EFFECTS, HYDROCARBONS, CRUSTACEANS, MOLLUSKS, *SHELLFISH, SOIL POLLUTION,
0289 BIOLOGICAL EFFECTS, OIL SPILLS, DISPERSANTS, MOLLUSKS, MARINE ORGANISMS, FRANCE,
*NORMAN COAST,
0291 BIOLOGICAL EFFECTS, CRUDE OIL, MARINE ORGANISMS, CRUSTACEANS, *OXYGEN CONSUMPTION,
0292 BIOLOGICAL EFFECTS, CONTAMINATION, CRUDE OIL, PETROLEUM PRODUCTS, FRESHWATER, CANADA,
*CHIRONOMIDAE,
0293 BIOLOGICAL EFFECTS, HYDROCARBONS, POLYCHAETES, FATE, *NEANTHES ARENACEODENTATA,
0294 BIOLOGICAL EFFECTS, OIL SPILLS, FUEL OIL, EMULSIFIERS, MARINE ORGANISMS, INTERTIDAL
ZONE, MASSACHUSETTS, *WEST FALMOUTH SPILL,
0295 BIOLOGICAL EFFECTS, BACTERIA, ALGAE, OIL SPILLS, FRESHWATER, CANADA,
0297 BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, LAKES, VENEZUELA, *LAKE MARACAIBO,
0298 BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, FISHERIES, LAKES, VENEZUELA,
ECONOMICS, *LAKE MARACAIBO,
0302 BIOLOGICAL EFFECTS, ALGAE, CRUDE OIL, HYDROCARBONS, *NAPHTHALENE, *ALGAL PHYSIOLOGY,
0303 BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, CANADA, COASTS,
0304 BIOLOGICAL EFFECTS, CRUDE OIL, CRUSTACEANS, MONITORING, TOXICITY, *AMERICAN LOBSTER,
0305 BIOLOGICAL EFFECTS, HYDROCARBONS, FISHES, TOXICITY, METABOLISM,
0306 BIOLOGICAL EFFECTS, METABOLISM, CRUDE OIL, POLYCHAETES, *NEANTHES ARENACEODENTATA,
0316 BIOLOGICAL EFFECTS, BEHAVIOR, OIL SPILLS, NORTH SEA, FATE, CLEANUP,
0318 BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES, ENVIRONMENTAL EFFECTS, MARINE ORGANISMS,
OIL SPILLS, CRUDE OIL, FATE, OCEANS,
0319 BIOLOGICAL EFFECTS, HYDROCARBONS, ENVIRONMENTAL EFFECTS, WASTEWATERS, *1,3-BUTADIENE,
0326 BIOLOGICAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS, OIL SPILLS, *DRILLING MUD
COMPONENTS,
0328 BIOLOGICAL EFFECTS, BERMUDA COAST, OFFSHORE PRODUCTION, MARINE ORGANISMS, MEXICO/GULF
OF, VENEZUELA, NATURAL SEEPAGE, SANTA BARBARA CHANNEL, TAR,
0329 BIOLOGICAL EFFECTS, OFFSHORE PRODUCTION, FISHERIES, CRUDE OIL, TOXICITY, LOUISIANA,
0331 BIOLOGICAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS,
0367 BIOLOGICAL EFFECTS, BEHAVIOR, OFFSHORE PRODUCTION, NORTH SEA, OIL SPILLS, MONITORING,
POLLUTION CONTROL,
0373 BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS,
0391 BIOLOGICAL EFFECTS, BEHAVIOR, OIL SPILLS, *FREEZING CONDITIONS, EVAPORATION, MARINE
ORGANISMS,
0397 BIOLOGICAL EFFECTS, OIL SPILLS, FATE, DISTRIBUTION, HYDROCARBONS, *SALT MARSH,
0409 BIOLOGICAL EFFECTS, TOXICITY, FATE, CRUDE OIL, DECOMPOSITION, ENVIRONMENTAL EFFECTS,
0438 BIOLOGICAL EFFECTS, BIBLIOGRAPHIES, OIL SPILLS, PETROCHEMICALS, MARINE ORGANISMS,
PUGET SOUND,
0445 BIOLOGICAL EFFECTS, BIBLIOGRAPHIES, OIL SPILLS, ENVIRONMENTAL EFFECTS, TOXICITY,

MARINE ORGANISMS,
0086 BIOLOGICAL EFFECTS, BIODEGRADATION, BIBLIOGRAPHIES, ENVIRONMENTAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, *TROPICAL WATERS,
0027 BIRDS, BEACHES, OIL SPILLS, FUEL OIL, CHESAPEAKE BAY, MARINE ORGANISMS, *OIL BARGE,
0028 BIRDS, ALGAE, OIL SLICKS, ESTUARIES, UK, SOURCE IDENTIFICATION,
0036 BIRDS, OIL SPILLS, FUEL OIL, ENVIRONMENTAL EFFECTS, SCOTLAND, *SANDS OF FORVIE,
0061 BIRDS, MONITORING, CONTAMINATION, OIL SPILLS, COASTS, CANADA,
0066 BIRDS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS, *SUBANTARCTIC PELAGIC BIRDS, *STOMACH OIL, MONITORING,
0254 BIRDS, OIL SPILLS, ST. LAWRENCE RIVER, GOVERNMENT AGENCIES, U.S., CANADA, CLEANUP, RESTORATION,
0260 BIRDS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, FISHERIES, SCOTLAND, *CONFERENCE,
0270 BIRDS, BIOLOGICAL EFFECTS, FUEL OIL, OIL SPILLS, SCOTLAND, POLLUTION CONTROL, *RIVER YTHAN,
0271 BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, CANADA, *BAY OF FUNDY, CHRONIC EFFECTS,
0273 BIRDS, ACUTE EFFECTS, CHRONIC EFFECTS, OIL SPILLS, POLLUTION PREVENTION, CONSERVATION,
0303 BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, CANADA, COASTS,
0233 BLOWOUT PREVENTION, DRILLING, DESIGN-ENGINEERING, *DROP-IN VALVE,
0237 BLOWOUT PREVENTION, DETECTION, POLLUTION PREVENTION, DRILLING, OIL WELLS,
0246 BLOWOUT PREVENTION, BEAUFORT SEA, DRILLING, OIL SPILLS, CLEANUP, BOOMS, SKIMMERS, CONTINGENCY PLANNING,
0255 BLOWOUT PREVENTION, POLLUTION PREVENTION, DRILLING, OIL WELLS,
0019 BOOMS, OIL SPILLS, POLLUTION CONTROL, USSR, CLEANUP, SKIMMERS, DISPERSANTS,
0088 BOOMS, CONTAINMENT, OIL SPILLS, *MATERIALS EVALUATION,
0089 BOOMS, CONTAINMENT, OIL SPILLS, DESIGN-ENGINEERING,
0090 BOOMS, CONTAINMENT, OIL SPILLS, DESIGN-ENGINEERING,
0091 BOOMS, CONTAINMENT, OIL SPILLS, CLEANUP, DESIGN-ENGINEERING,
0106 BOOMS, CLEANUP, RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0246 BOOMS, BLOWOUT PREVENTION, BEAUFORT SEA, DRILLING, OIL SPILLS, CLEANUP, SKIMMERS, CONTINGENCY PLANNING,
0255 BOOMS, OIL SPILLS, POLLUTION PREVENTION, CONTINGENCY PLANNING, SKIMMERS, MONITORING,
0068 CALIFORNIA, ALGAE, HYDROCARBONS, SAN FRANCISCO BAY, CARCINOGENS, PAH, ESTUARIES, FOOD WEB,
0070 CALIFORNIA, ANALYTICAL TECHNIQUES, OIL SPILLS, SEAWATER, *LUMINESCENCE SIGNATURES, *LOS ANGELES HARBOR,
0134 CALIFORNIA, ALASKA, ECONOMIC EFFECTS, GUIDELINES, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, MEXICO/GULF OF,
0135 CALIFORNIA, BIODEGRADATION, ECONOMICS, MODELS, REFINERIES, OIL SPILLS, *CRUDE OIL COSTS,
0002 CALIFORNIA/SOUTHERN, NATURAL SEEPAGE, *COAL OIL POINT, *GEOLOGIC HISTORY,
0006 CANADA, OIL SPILLS, INLAND, CRUDE OIL, FUEL OIL, U.S.,
0015 CANADA, OIL SPILLS, INFORMATION SYSTEMS,
0061 CANADA, BIRDS, MONITORING, CONTAMINATION, OIL SPILLS, COASTS,
0088 CANADA, ANALYTICAL TECHNIQUES, HYDROCARBONS, SEAWATER, SPECTROSCOPY, REFINERIES, ENVIRONMENTAL EFFECTS, *COME-BY-CHANCE BAY,
0108 CANADA, CLEANUP, OIL SPILLS, DISPOSAL, INCINERATION,
0120 CANADA, BIBLIOGRAPHIES, OIL SPILLS, DISPERSANTS, TOXICITY, REGULATIONS,
0231 CANADA, BEAUFORT SEA, CONTINGENCY PLANNING, OIL SPILLS, GOVERNMENT AGENCIES, OIL INDUSTRY,
0244 CANADA, POLLUTION PREVENTION, OIL SPILLS, GOVERNMENT AGENCIES, INDUSTRIES, LEGISLATION, PERSONNEL TRAINING,
0245 CANADA, OIL SPILLS, POLLUTION PREVENTION, POLLUTION CONTROL, LEGISLATION, U.S., CONTINGENCY PLANNING, OIL DISCHARGES,
0254 CANADA, BIRDS, OIL SPILLS, ST. LAWRENCE RIVER, GOVERNMENT AGENCIES, U.S., CLEANUP, RESTORATION,
0271 CANADA, BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, *BAY OF FUNDY, CHRONIC EFFECTS,
0292 CANADA, BIOLOGICAL EFFECTS, CONTAMINATION, CRUDE OIL, PETROLEUM PRODUCTS, FRESHWATER, *CHIRONOMIDAE,
0295 CANADA, BIOLOGICAL EFFECTS, BACTERIA, ALGAE, OIL SPILLS, FRESHWATER,
0303 CANADA, BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, COASTS,
0312 CANADA, ARCTIC, WATER QUALITY, OIL SPILLS, ENVIRONMENTAL EFFECTS,
0325 CANADA, BIODEGRADATION, ENVIRONMENTAL EFFECTS, FUEL OIL, OIL SPILLS, SHORELINES, MARINE ORGANISMS, CHEDABUCTO BAY,
0339 CANADA, OIL SPILLS, FISHERIES, PORTS, ECONOMICS, CLEANUP, *BAY OF FUNDY,
0351 CANADA, PRODUCTION, TAR SANDS, CONTAMINATION, WATER QUALITY, *ATHABASCA OIL SANDS,
0355 CANADA, BEAUFORT SEA, DRILLING, OIL SPILLS, MOVEMENT, *OIL-IN-ICE,
0360 CANADA, TAR SANDS, DEVELOPMENT, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS,
0392 CANADA, BEHAVIOR, BEACHES, FATE, OIL SPILLS, SEDIMENTS, *NOVA SCOTIA,
0396 CANADA, BEACHES, DISTRIBUTION, CONTAMINANTS, SEDIMENTS, *NOVA SCOTIA, *HALIFAX HARBOUR,
0412 CANADA, OIL SLICKS, MOVEMENT, MODELS, ST. LAWRENCE RIVER,
0415 CANADA, BEACHES, FATE, FUEL OIL, CHEDABUCTO BAY, SEDIMENTS, *WATER COLUMN, MARINE ORGANISMS, CHRONIC EFFECTS,
0422 CANADA, REGULATIONS, U.S., CRUDE OIL, *RESOURCE ALLOCATIONS, EIS, ECONOMIC EFFECTS, *OCS,
0016 CARCINOGENS, PAH, CONTAMINATION, *FOODS, HEALTH HAZARDS,

0021 CARCINOGENS, OIL TRANSPORT, CRUDE OIL, PETROLEUM PRODUCTS, OIL DISCHARGES, OCEANS,
0066 CARCINOGENS, CALIFORNIA, ALGAE, HYDROCARBONS, SAN FRANCISCO BAY, PAH, ESTUARIES, FOOD WEB,
0253 CARIBBEAN SEA, POLLUTION CONTROL, REFINERIES, ENVIRONMENTAL PROTECTION,
0398 CARIBBEAN SEA, OCS, OFFSHORE PRODUCTION, PIPELINES,
0320 CHEDABUCTO BAY, CANADA, BIODEGRADATION, ENVIRONMENTAL EFFECTS, FUEL OIL, OIL SPILLS, SHORELINES, MARINE ORGANISMS,
0618 CHEDABUCTO BAY, CANADA, BEACHES, FATE, FUEL OIL, SEDIMENTS, *WATER COLUMN, MARINE ORGANISMS, CHRONIC EFFECTS,
0035 CHEMICAL ANALYSIS, BEACHES, MONITORING, HYDROCARBONS, MEXICO/GULF OF,
0059 CHEMICAL ANALYSIS, ADRIATIC SEA, SAMPLING, MOLLUSKS, HYDROCARBONS, CHROMATOGRAPHY, *MUSSELS, *GULF OF VENICE,
0054 CHEMICAL ANALYSIS, BIRDS, CHROMATOGRAPHY, HYDROCARBONS, *SUBANTARCTIC PELAGIC BIRDS, *STOMACH OIL, MONITORING,
0067 CHEMICAL ANALYSIS, PAH, *BENZO(A)PYRENE, CHROMATOGRAPHY, *FLUORIMETRY, MONITORING, MARINE ORGANISMS, SEDIMENTS,
0069 CHEMICAL ANALYSIS, CHROMATOGRAPHY, PAH, PETROLEUM PRODUCTS, GASOLINE,
0073 CHEMICAL ANALYSIS, OIL SPILLS, CHROMATOGRAPHY, SPECTROMETRY, SAMPLING,
0074 CHEMICAL ANALYSIS, PAH, FISHES, CHROMATOGRAPHY, CONTAMINATION,
0076 CHEMICAL ANALYSIS, HYDROCARBONS, DETECTION, SAMPLING, DESIGN-ENGINEERING,
0078 CHEMICAL ANALYSIS, HYDROCARBONS, SAMPLING, SEAWATER, *SURFACE MICROLAYER,
0079 CHEMICAL ANALYSIS, PAH, CHROMATOGRAPHY, MARINE ORGANISMS, *SHELLFISH,
0084 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, PETROLEUM PRODUCTS, SAMPLING,
0085 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, CHROMATOGRAPHY, STATISTICAL ANALYSIS,
0086 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, CONTAMINANTS, CHROMATOGRAPHY, FUEL OIL, GASOLINE, *FLUORESCENCE,
0163 CHEMICAL ANALYSIS, DISPOSAL, *ORGANIC WASTES, WATER QUALITY, SEDIMENTS, SEAWATER, FRESHWATER, HYDROCARBONS,
0266 CHEMICAL ANALYSIS, CRUDE OIL, HYDROCARBONS, TOXICITY, FISHES, CRUSTACEANS,
0363 CHEMICAL ANALYSIS, SAMPLING, GREAT LAKES, SEDIMENTS, DISTRIBUTION, *DREDGED SPOILS,
0390 CHEMICAL ANALYSIS, BEACHES, CRUDE OIL, FATE, CHROMATOGRAPHY, COASTS, INDIA, *TAR BALLS,
0333 CHEMICAL EFFECTS, HYDROCARBONS, SEDIMENTS, OIL FIELDS, MICROORGANISMS, LOUISIANA, *PETROLEUM DEGRADATION,
0027 CHESAPEAKE BAY, BIRDS, BEACHES, OIL SPILLS, FUEL OIL, MARINE ORGANISMS, *OIL BARGE,
0386 CHESAPEAKE BAY, BIODEGRADATION, BACTERIA, CONTAMINANTS, METABOLISM, HARBORS, *MERCURY INHIBITION,
0058 CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, SAMPLING, OIL SLICKS, SPECTROMETRY,
0059 CHROMATOGRAPHY, CHEMICAL ANALYSIS, ADRIATIC SEA, SAMPLING, MOLLUSKS, HYDROCARBONS, *MUSSELS, *GULF OF VENICE,
0061 CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, OIL SPILLS, HYDROCARBONS, *LUMINESCENCE,
0054 CHROMATOGRAPHY, CHEMICAL ANALYSIS, BIRDS, HYDROCARBONS, *SUBANTARCTIC PELAGIC BIRDS, *STOMACH OIL, MONITORING,
0067 CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH, *BENZO(A)PYRENE, *FLUORIMETRY, MONITORING, MARINE ORGANISMS, SEDIMENTS,
0069 CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH, PETROLEUM PRODUCTS, GASOLINE,
0073 CHROMATOGRAPHY, CHEMICAL ANALYSIS, OIL SPILLS, SPECTROMETRY, SAMPLING,
0074 CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH, FISHES, CONTAMINATION,
0075 CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, CRUDE OIL, SPECTROSCOPY, SOURCE IDENTIFICATION, *LUMINESCENCE,
0079 CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH, MARINE ORGANISMS, *SHELLFISH,
0085 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, STATISTICAL ANALYSIS,
0086 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, CONTAMINANTS, FUEL OIL, GASOLINE, *FLUORESCENCE,
0390 CHROMATOGRAPHY, CHEMICAL ANALYSIS, BEACHES, CRUDE OIL, FATE, COASTS, INDIA, *TAR BALLS,
0126 CHRONIC EFFECTS, OIL TRANSPORT, OIL SPILLS, ENVIRONMENTAL DETERIORATION, MARINE ORGANISMS,
0263 CHRONIC EFFECTS, ACUTE EFFECTS, OIL SPILLS, PETROLEUM PRODUCTS, REFINERIES, MARINE ORGANISMS, MONITORING,
0271 CHRONIC EFFECTS, CANADA, BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, *BAY OF FUNDY,
0272 CHRONIC EFFECTS, BIRDS, ACUTE EFFECTS, OIL SPILLS, POLLUTION PREVENTION, CONSERVATION,
0276 CHRONIC EFFECTS, ACUTE EFFECTS, TOXICITY, CRUDE OIL, FUEL OIL, METABOLISM, CRUSTACEANS, *MUD CRAB,
0277 CHRONIC EFFECTS, ALASKA, CONTAMINATION, OIL SPILLS, ECOSYSTEMS, OCS, PIPELINES,
0280 CHRONIC EFFECTS, ACUTE EFFECTS, OIL SPILLS, DISPERSANTS, TOXICITY, MARINE ORGANISMS,
0296 CHRONIC EFFECTS, PRODUCTION, ENVIRONMENTAL EFFECTS, *OIL POLLUTION,
0618 CHRONIC EFFECTS, CHEDABUCTO BAY, CANADA, BEACHES, FATE, FUEL OIL, SEDIMENTS, *WATER COLUMN, MARINE ORGANISMS,
0012 CLEANUP, OIL SPILLS, INFORMATION SYSTEMS, ENVIRONMENTAL PROTECTION, CONTINGENCY PLANNING, ECONOMICS, *DATA BASE, *U.S. NAVY,
0019 CLEANUP, BOOMS, OIL SPILLS, POLLUTION CONTROL, USSR, SKIMMERS, DISPERSANTS,
0020 CLEANUP, ACUTE EFFECTS, OIL SPILLS, TANKERS, DISPERSANTS, MARINE ORGANISMS, SPAIN, *URQUIOLA OIL SPILL,
0022 CLEANUP, OIL SPILLS, CRUDE OIL, UK, *DOVER STRAIT,

0048 CLEANUP, REMOTE SENSING, OIL SLICKS, CONTAINMENT, *PERFORMANCE TESTS, *MICROWAVE EQUIPMENT,
0061 CLEANUP, BOOMS, CONTAINMENT, OIL SPILLS, DESIGN-ENGINEERING,
0068 CLEANUP, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING, *FERROMAGNETIC POLYFOAM CHIPS,
0086 CLEANUP, WASTEWATER TREATMENT, OIL TANKS, OIL-WATER SEPARATION, *FOAM,
0098 CLEANUP, OIL SPILLS, CRUDE OIL, EVAPORATION, DECOMPOSITION, *LASERS,
0099 CLEANUP, CONTAMINATION, SEDIMENTS, DESIGN-ENGINEERING,
0100 CLEANUP, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING, *U.S. NAVY, *POLYURETHANE FOAM CHIPS,
0101 CLEANUP, RECOVERY, OIL SPILLS, SKIMMERS, OIL-WATER SEPARATION, NORWEGIAN SEA,
0102 CLEANUP, ABSORPTION, RECOVERY, OIL SPILLS,
0105 CLEANUP, BOOMS, RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0106 CLEANUP, RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0107 CLEANUP, FUELS, *FUEL SPILLS, *NEUTRALIZATION,
0108 CLEANUP, CANADA, OIL SPILLS, DISPOSAL, INCINERATION,
0110 CLEANUP, OIL SPILLS, DISPERSANTS, SURFACTANTS,
0111 CLEANUP, OIL SPILLS, DISPERSANTS, SURFACTANTS,
0112 CLEANUP, RECOVERY, OIL SPILLS, OIL-WATER SEPARATION,
0114 CLEANUP, OIL SPILLS, RECOVERY, DESIGN-ENGINEERING, *EQUIPMENT EVALUATION,
0115 CLEANUP, ABSORPTION, OIL SPILLS, RECOVERY, *POLYETHYLENE FOAM,
0117 CLEANUP, CONTAMINATION, SOILS, *SORBENTS,
0121 CLEANUP, CONTAMINATION, STORAGE, OIL TANKS, *RESIDUAL OIL, EMULSIFICATION,
0125 CLEANUP, OIL SPILLS, RECOVERY, *FERROMAGNETIC GRANULES,
0207 CLEANUP, OIL SPILLS, PERSONNEL TRAINING, UK, *POLLUTION CLEANUP FILM,
0222 CLEANUP, ALASKA, CONTINGENCY PLANNING, OIL SPILLS, PIPELINES, RESTORATION,
0228 CLEANUP, CONTINGENCY PLANNING, OIL SPILLS, POLLUTION PREVENTION, TANKERS, GOVERNMENT AGENCIES, *U.S. [illegible]
0230 CLEANUP, POLLUTION CONTROL, OIL SPILLS, CONTINGENCY PLANNING, PERSONNEL TRAINING,
0231 CLEANUP, OIL SPILLS, OCEANS, POLLUTION PREVENTION, REGULATIONS, UK,
0233 CLEANUP, AUSTRALIA, POLLUTION PREVENTION, OIL SPILLS, CONTINGENCY PLANNING,
0246 CLEANUP, BEAUFORT SEA, ARCTIC, OIL SPILLS, POLLUTION CONTROL,
0249 CLEANUP, BOOMS, BLOWOUT PREVENTION, BEAUFORT SEA, DRILLING, OIL SPILLS, SKIMMERS, CONTINGENCY PLANNING,
0251 CLEANUP, OIL SPILLS, ST. LAWRENCE RIVER, POLLUTION CONTROL, CONTINGENCY PLANNING, PERSONNEL TRAINING, *FIELD TESTS,
0255 CLEANUP, CANADA, BIRDS, OIL SPILLS, ST. LAWRENCE RI , GOVERNMENT AGENCIES, U.S., RESTORATION,
0267 CLEANUP, ECONOMICS, FUEL OIL,
0316 CLEANUP, BIOLOGICAL EFFECTS, BEHAVIOR, OIL SPILLS, NORTH SEA, FATE,
0329 CLEANUP, OIL SPILLS, TANKERS, ENVIRONMENTAL EFFECTS, POLLUTION CONTROL, INTERNATIONAL CONVENTIONS, CONTINGENCY PLANNING,
0335 CLEANUP, CANADA, OIL SPILLS, FISHERIES, PORTS, ECONOMICS, *BAY OF FUNDY,
0375 CLEANUP, BIODEGRADATION, OIL SPILLS, MICROORGANISMS, *NUTRIENT ADDITION,
0376 CLEANUP, BIODEGRADATION, BILGES, BALLAST, OIL SPILLS, OIL TANKS, WASTEWATER TREATMENT, RECLAMATION, PETROLEUM PRODUCTS,
0377 CLEANUP, BIODEGRADATION, BACTERIA, CRUDE OIL, MICROORGANISMS, MONITORING, OIL SPILLS,
0424 CLEANUP, LEGISLATION, EUROPE, INTERNATIONAL AGREEMENTS, POLLUTION PREVENTION, OCEANS, OFFSHORE PRODUCTION, OIL DISCHARGES,
0425 CLEANUP, MANUALS, OIL SPILLS, POLLUTION PREVENTION, CONTAINMENT, GUIDELINES,
0447 CLEANUP, BIBLIOGRAPHIES, ADSORPTION, OIL SPILLS, RECOVERY, OIL-WATER SEPARATION, SKIMMERS, DISPERSANTS, FLOTATION,
0136 COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, OXIDATION, SLUDGE,
0207 COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION, FILTRATION,
0209 COAGULATION, WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION,
0182 COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0186 COALESCENCE, BILGES, BALLAST, WASTEWATER TREATMENT, OIL-WATER SEPARATION, WASTEWATER DISPOSAL,
0180 COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, DISPERSIONS, *SULFUR,
0185 COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, *OIL WETTABILITY,
0187 COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, DESIGN-ENGINEERING,
0061 COASTS, CANADA, BIRDS, MONITORING, CONTAMINATION, OIL SPILLS,
0069 COASTS, REMOTE SENSING, SEDIMENTS, CORAL REEFS, OIL SLICKS, PUERTO RICO, VIRGIN ISLANDS, *SKYLAB,
0235 COASTS, GOVERNMENT AGENCIES, GERMANY, WEST, POLLUTION PREVENTION, OIL SPILLS, OCEANS,
0257 COASTS, OIL SPILLS, LOUISIANA, ENVIRONMENTAL PROTECTION, PORTS,
0303 COASTS, CANADA, BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS,
0309 COASTS, OIL SPILLS, INDONESIA, ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING,
0351 COASTS, ALASKA, HYDROCARBONS, MARINE ORGANISMS, SEDIMENTS, PRUDHOE BAY,
0352 COASTS, OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION, SOCIO-ECONOMIC EFFECTS,
0361 COASTS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, FLORIDA, GUIDELINES, *ONSHORE EFFECTS,
0387 COASTS, ENVIRONMENTAL EFFECTS, OCS, OFFSHORE DEVELOPMENT, OFFSHORE PRODUCTION, OIL INDUSTRY, FISHERIES, SCOTLAND,

0392 COASTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, BEACHES, CRUDE OIL, FATE, INDIA, *TAR BALLS,
0187 CONSERVATION, AUSTRALIA, REFINERIES, WASTEWATER TREATMENT, PETROCHEMICALS, OIL SPILLS,
0272 CONSERVATION, CHRONIC EFFECTS, BIRDS, ACUTE EFFECTS, OIL SPILLS, POLLUTION PREVENTION,
0366 CONSERVATION, ENVIRONMENTAL EFFECTS, SOCIAL EFFECTS, ENVIRONMENTAL OIL INDUSTRY, OCS,
DEVELOPMENT, SCOTLAND,
0049 CONTAINMENT, CLEANUP, REMOTE SENSING, OIL SLICKS, *PERFORMANCE TESTS, *MICROWAVE
EQUIPMENT,
0088 CONTAINMENT, BOOMS, OIL SPILLS, *MATERIALS EVALUATION,
0089 CONTAINMENT, BOOMS, OIL SPILLS, DESIGN-ENGINEERING,
0090 CONTAINMENT, BOOMS, OIL SPILLS, DESIGN-ENGINEERING,
0091 CONTAINMENT, CLEANUP, BOOMS, OIL SPILLS, DESIGN-ENGINEERING,
0092 CONTAINMENT, ARCTIC, FUELS, PETROLEUM PRODUCTS, STORAGE, *SPILL CONTAINMENT DIKES,
0033 CONTAINMENT, CLEANUP, MANUALS, OIL SPILLS, POLLUTION PREVENTION, GUIDELINES,
0036 CONTAMINANTS, MONITORING, REMOTE SENSING, PETROLEUM PRODUCTS, WATER QUALITY, *AIR
QUALITY,
0077 CONTAMINANTS, ANALYTICAL TECHNIQUES, HYDROCARBONS, *AIR QUALITY, WATER QUALITY,
0086 CONTAMINANTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, FUEL OIL,
GASOLINE, *FLUORESCENCE,
0165 CONTAMINANTS, WASTEWATER TREATMENT, INDUSTRIES, FLOCCULATION, *POLYELECTROLYTES,
0171 CONTAMINANTS, WASTEWATER TREATMENT, RECOVERY, PETROLEUM PRODUCTS,
0281 CONTAMINANTS, METABOLISM, MARINE ORGANISMS, TOXICITY,
0388 CONTAMINANTS, CHESAPEAKE BAY, BIODEGRADATION, BACTERIA, METABOLISM, HARBORS, *MERCURY
INHIBITION,
0396 CONTAMINANTS, CANADA, BEACHES, DISTRIBUTION, SEDIMENTS, *NOVA SCOTIA, *HALIFAX HARBOUR,
0003 CONTAMINATION, BEACHES, WASTE OIL, *SEWAGE, NEW YORK,
0012 CONTAMINATION, MEDITERRANEAN SEA, HYDROCARBONS, OIL DISCHARGES, TANKERS, REFINERIES,
0015 CONTAMINATION, CARCINOGENS, PAH, *FOODS, HEALTH HAZARDS,
0023 CONTAMINATION, BIOLOGICAL EFFECTS, OIL SPILLS, JAPAN, LEGISLATION, POLLUTION
PREVENTION,
0061 CONTAMINATION, COASTS, CANADA, BIRDS, MONITORING, OIL SPILLS,
0076 CONTAMINATION, CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH, FISHES,
0095 CONTAMINATION, CLEANUP, SEDIMENTS, DESIGN-ENGINEERING,
0117 CONTAMINATION, CLEANUP, SOIL, *DETERGENTS,
0121 CONTAMINATION, CLEANUP, STORAGE, OIL TANKS, *RESIDUAL OIL, EMULSIFICATION,
0129 CONTAMINATION, BALLAST, TANKERS, OIL TRANSPORT, OIL DISCHARGES, POLLUTION CONTROL,
REGULATIONS,
0157 CONTAMINATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, DETECTION,
DESIGN-ENGINEERING,
0262 CONTAMINATION, BIOLOGICAL EFFECTS, SEDIMENTS, *CORALS,
0277 CONTAMINATION, CHRONIC EFFECTS, ALASKA, OIL SPILLS, ECOSYSTEMS, EIS, PIPELINES,
0278 CONTAMINATION, BIOLOGICAL EFFECTS, CRUDE OIL, MARINE MAMMALS, *RINGED SEALS, OFFSHORE
DEVELOPMENT,
[illegible]2 CONTAMINATION, CANADA, BIOLOGICAL EFFECTS, CRUDE OIL, PETROLEUM PRODUCTS, FRESHWATER,
*CHIRONOMIDAE,
0306 CONTAMINATION, OCEANS, ENGLAND, *ADVISORY COMMITTEE ON OIL POLLUTION,
0311 CONTAMINATION, MARINE ORGANISMS, *MARINE ECOLOGY,
0312 CONTAMINATION, OCEANS, HYDROCARBONS, *MARINE POLLUTANTS, ENVIRONMENTAL EFFECTS,
0316 CONTAMINATION, ENVIRONMENTAL PROTECTION, MARINE ORGANISMS, GUIDELINES,
0351 CONTAMINATION, CANADA, PRODUCTION, TAR SANDS, WATER QUALITY, *ATHABASCA OIL SANDS,
0408 CONTAMINATION, ALASKA/GULF OF, OFFSHORE DEVELOPMENT, FATE, *SEISMICITY, *GROUND
SHAKING,
0430 CONTAMINATION, INTERNATIONAL CONVENTIONS, OIL SPILLS, ENVIRONMENTAL EFFECTS, OCEANS,
*OCEANS,
0012 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, INFORMATION SYSTEMS, ENVIRONMENTAL
PROTECTION, ECONOMICS, *DATA BASE, *U.S. NAVY,
0018 CONTINGENCY PLANNING, OIL SPILLS, INLAND, POLLUTION PREVENTION, LEGISLATION,
LIABILITY, *REPORTING REQUIREMENTS,
0228 CONTINGENCY PLANNING, CLEANUP, ALASKA, OIL SPILLS, PIPELINES, RESTORATION,
0229 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, POLLUTION PREVENTION, TANKERS, GOVERNMENT
AGENCIES, *U.S.C.G.,
0230 CONTINGENCY PLANNING, ATLANTIC COAST, OIL SPILLS, OFFSHORE DRILLING, OCS, OIL
TRANSPORT, *RESEARCH NEEDS, *U.S. EPA,
0231 CONTINGENCY PLANNING, CANADA, BEAUFORT SEA, OIL SPILLS, GOVERNMENT AGENCIES, OIL
INDUSTRY,
0237 CONTINGENCY PLANNING, POLLUTION PREVENTION, OIL SPILLS, STORAGE, DISCHARGES,
LEGISLATION, *FWPCA,
0239 CONTINGENCY PLANNING, CLEANUP, POLLUTION CONTROL, OIL SPILLS, PERSONNEL TRAINING,
0243 CONTINGENCY PLANNING, CLEANUP, AUSTRALIA, POLLUTION PREVENTION, OIL SPILLS,
0245 CONTINGENCY PLANNING, CANADA, OIL SPILLS, POLLUTION PREVENTION, POLLUTION CONTROL,
LEGISLATION, U.S., OIL DISCHARGES,
0249 CONTINGENCY PLANNING, CLEANUP, BOOMS, BLOWOUT PREVENTION, BEAUFORT SEA, DRILLING, OIL
SPILLS, SKIMMERS,
0251 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, ST. LAWRENCE RIVER, POLLUTION CONTROL,
PERSONNEL TRAINING, *FIELD TESTS,
0254 CONTINGENCY PLANNING, BOOMS, OIL SPILLS, POLLUTION PREVENTION, SKIMMERS, MONITORING,

0320 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, TANKERS, ENVIRONMENTAL EFFECTS, POLLUTION CONTROL, INTERNATIONAL CONVENTIONS,
0055 CORAL REEFS, COASTS, REMOTE SENSING, SEDIMENTS, OIL SLICKS, PUERTO RICO, VIRGIN ISLANDS, *SKYLAB,
0212 CRANKCASE OIL, RECLAMATION, WASTE OIL, LUBRICATING OIL, FUEL OIL,
0216 CRANKCASE OIL, RECLAMATION, LUBRICATING OIL, RECYCLING,
0219 CRANKCASE OIL, RECLAMATION, REFINING, INDIA,
0223 CRANKCASE OIL, REFINING, RECYCLING, WASTE OIL, INDIA,
0225 CRANKCASE OIL, RECYCLING, REUSE, LUBRICATING OIL, INDIA,
0386 CRANKCASE OIL, BIODEGRADATION, BACTERIA, METABOLISM, SOIL, FUEL OIL, CRUDE OIL,
0005 CRUDE OIL, PIPELINES, *OIL TERMINAL FIRE, OHIO,
0006 CRUDE OIL, CANADA, OIL SPILLS, INLAND, FUEL OIL, U.S.,
0010 CRUDE OIL, OIL SPILLS, UK, *CINES,
0021 CRUDE OIL, CARCINOGENS, OIL TRANSPORT, PETROLEUM PRODUCTS, OIL DISCHARGES, OCEANS,
0022 CRUDE OIL, CLEANUP, OIL SPILLS, UK, *DOVER STRAIT,
0075 CRUDE OIL, CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, SPECTROSCOPY, SOURCE IDENTIFICATION, *LUMINESCENCE,
0082 CRUDE OIL, ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, *LUMINESCENCE, LUBRICATING OIL,
0096 CRUDE OIL, CLEANUP, OIL SPILLS, EVAPORATION, DECOMPOSITION, *LASERS,
0116 CRUDE OIL, RECOVERY, OIL SPILLS, PETROLEUM PRODUCTS, DESIGN-ENGINEERING, *COLD WATER RECOVERY,
0125 CRUDE OIL, STORAGE, PETROLEUM PRODUCTS, SAFETY, LEAKAGE, ECONOMICS, *UNDERGROUND SALT CAVERNS,
0136 CRUDE OIL, STORAGE, ENVIRONMENTAL EFFECTS, EIS, *FEA, *SALT DOMES,
0137 CRUDE OIL, STORAGE, ENVIRONMENTAL EFFECTS, *FEA, *SALT DOMES,
0185 CRUDE OIL, TANKERS, SLUDGE, DISPOSAL, GUIDELINES,
0236 CRUDE OIL, POLLUTION PREVENTION, OIL TRANSFER, DESIGN-ENGINEERING, *SAFLOTE OIL HOSE,
0261 CRUDE OIL, BIOLOGICAL EFFECTS, DISPERSANTS, TOXICITY, MOLLUSKS, *RESPIRATION RATE,
0266 CRUDE OIL, CHEMICAL ANALYSIS, HYDROCARBONS, TOXICITY, FISHES, CRUSTACEANS,
0275 CRUDE OIL, CHRONIC EFFECTS, ACUTE EFFECTS, TOXICITY, FUEL OIL, METABOLISM, CRUSTACEANS, *MUD CRAB,
0276 CRUDE OIL, CONTAMINATION, BIOLOGICAL EFFECTS, MARINE MAMMALS, *RINGED SEALS, OFFSHORE DEVELOPMENT,
0283 CRUDE OIL, BIOLOGICAL EFFECTS, TOXICITY, EMULSIFIERS, FISHES,
0290 CRUDE OIL, ARCTIC, TOXICITY, MARINE ORGANISMS, INVERTEBRATES, METABOLISM,
0291 CRUDE OIL, BIOLOGICAL EFFECTS, MARINE ORGANISMS, CRUSTACEANS, *OXYGEN CONSUMPTION,
0292 CRUDE OIL, CONTAMINATION, CANADA, BIOLOGICAL EFFECTS, PETROLEUM PRODUCTS, FRESHWATER, *CHIRONOMIDAE,
0301 CRUDE OIL, ALGAE, FATE, PAH, HYDROCARBONS, SEDIMENTS, ESTUARIES, ENGLAND, *DIATOMS,
0302 CRUDE OIL, BIOLOGICAL EFFECTS, ALGAE, HYDROCARBONS, *NAPHTHALENE, *ALGAL PHYSIOLOGY,
0305 CRUDE OIL, BIOLOGICAL EFFECTS, CRUSTACEANS, MONITORING, TOXICITY, *AMERICAN LOBSTER,
0306 CRUDE OIL, BIOLOGICAL EFFECTS, METABOLISM, POLYCHAETES, *NEANTHES ARENACEODENTATA,
0310 CRUDE OIL, BEACHES, OIL SPILLS, TANKERS, JAPAN, *NIIGATA COAST,
0315 CRUDE OIL, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES, ENVIRONMENTAL EFFECTS, MARINE ORGANISMS, OIL SPILLS, FATE, OCEANS,
0321 CRUDE OIL, *PARTITIONING STUDIES, *MERCURY, *HCB, SEDIMENTS, FRESHWATER, SEAWATER,
0329 CRUDE OIL, BIOLOGICAL EFFECTS, OFFSHORE PRODUCTION, FISHERIES, TOXICITY, LOUISIANA,
0337 CRUDE OIL, REFINERIES, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER TREATMENT, OIL INDUSTRY, *U.S. EPA,
0338 CRUDE OIL, REFINERIES, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER TREATMENT, OIL INDUSTRY, *U.S. EPA,
0377 CRUDE OIL, CLEANUP, BIODEGRADATION, BACTERIA, MICROORGANISMS, MONITORING, OIL SPILLS,
0378 CRUDE OIL, BIODEGRADATION, BEACHES, OXIDATION, MICROORGANISMS, MONITORING,
0379 CRUDE OIL, BIODEGRADATION, DECOMPOSITION, MICROORGANISMS, *MINERAL OIL,
0382 CRUDE OIL, BIODEGRADATION, BACTERIA, PETROCHEMICALS,
0386 CRUDE OIL, CRANKCASE OIL, BIODEGRADATION, BACTERIA, METABOLISM, SOIL, FUEL OIL,
0389 CRUDE OIL, BIODEGRADATION, ANALYTICAL TECHNIQUES, HYDROCARBONS, SPECTROMETRY,
0399 CRUDE OIL, COASTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, BEACHES, FATE, INDIA, *TAR BALLS,
0403 CRUDE OIL, BIODEGRADATION, FATE, OCEANS, EVAPORATION, WEATHERING,
0405 CRUDE OIL, BIOLOGICAL EFFECTS, ARCTIC, FATE, DECOMPOSITION, ENVIRONMENTAL EFFECTS,
0422 CRUDE OIL, CANADA, REGULATIONS, U.S., *RESOURCE ALLOCATIONS, EIS, ECONOMIC EFFECTS, *FEA,
0423 CRUDE OIL, LEGISLATION, U.S., STORAGE, OIL TANKS, EIS, ENVIRONMENTAL EFFECTS,
0053 CRUSTACEANS, BIODEGRADATION, BALTIC SEA, BACTERIA, MONITORING, HYDROCARBONS, FISHES,
0269 CRUSTACEANS, FATE, HYDROCARBONS, MARINE ORGANISMS, FUEL OIL, FISHES, MOLLUSKS, *ACCUMULATION AND RELEASE STUDIES,
0266 CRUSTACEANS, CRUDE OIL, CHEMICAL ANALYSIS, HYDROCARBONS, TOXICITY, FISHES,
0275 CRUSTACEANS, CRUDE OIL, CHRONIC EFFECTS, ACUTE EFFECTS, TOXICITY, FUEL OIL, METABOLISM, *MUD CRAB,
0285 CRUSTACEANS, FATE, HYDROCARBONS, METABOLISM, *BLUE CRAB,
0287 CRUSTACEANS, BIOLOGICAL EFFECTS, HYDROCARBONS, MOLLUSKS, *SHELLFISH, *OIL POLLUTION,
0291 CRUSTACEANS, CRUDE OIL, BIOLOGICAL EFFECTS, MARINE ORGANISMS, *OXYGEN CONSUMPTION,
0299 CRUSTACEANS, TOXICITY, HYDROCARBONS, *ESTUARINE GRASS SHRIMP, *PALAEMONETES PUGIO,
0305 CRUSTACEANS, CRUDE OIL, BIOLOGICAL EFFECTS, MONITORING, TOXICITY, *AMERICAN LOBSTER,

0098 DECOMPOSITION, CRUDE OIL, CLEANUP, OIL SPILLS, EVAPORATION, *LASERS,
0379 DECOMPOSITION, CRUDE OIL, BIODEGRADATION, MICROORGANISMS, *MINERAL OIL,
0409 DECOMPOSITION, CRUDE OIL, BIOLOGICAL EFFECTS, ARCTIC, FATE, ENVIRONMENTAL EFFECTS,
0410 DECOMPOSITION, HYDROCARBONS, JAPAN, *HEXADECANE, *SHIMODA BAY,
0411 DECOMPOSITION, HYDROCARBONS, *HEXADECANE, SEAWATER, JAPAN,
0358 DELAWARE, LEGISLATION, U.S., OFFSHORE DEVELOPMENT, OCS, LIABILITY, OIL SPILLS,
ENVIRONMENTAL PROTECTION,
0067 DELAWARE BAY, REMOTE SENSING, OIL SLICKS, MODELS, MOVEMENT,
0069 DELAWARE BAY, REMOTE SENSING, ESTUARIES, DRIFT, SPREADING, OIL SLICKS, MODELS, *FRONTS,
0024 DETECTION, MONITORING, TAR, OCEANS, DISTRIBUTION,
0030 DETECTION, BALTIC SEA, MONITORING, HYDROCARBONS, MOLLUSKS, *BLUE MUSSEL, *KIEL BIGHT,
0033 DETECTION, MONITORING, *OIL-IN-WATER, SHIPS, DESIGN-ENGINEERING,
0036 DETECTION, MONITORING, *OIL-IN-WATER, SHIPS, *LASER SPECTROSCOPY,
0051 DETECTION, REMOTE SENSING, OIL SLICKS, *INFRARED SENSORS,
0056 DETECTION, REMOTE SENSING, OIL SLICKS, OIL SPILLS, *RADAR,
0057 DETECTION, REMOTE SENSING, OIL SPILLS, NATURAL SEEPAGE, *FRAUNHOFER LINE DISCRIMINATOR,
0060 DETECTION, SAMPLING, HYDROCARBONS, SOLUBILITY, SEAWATER,
0076 DETECTION, CHEMICAL ANALYSIS, HYDROCARBONS, SAMPLING, DESIGN-ENGINEERING,
0157 DETECTION, CONTAMINATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
DESIGN-ENGINEERING,
0262 DETECTION, BLOWOUT PREVENTION, POLLUTION PREVENTION, DRILLING, OIL WELLS,
0365 DEVELOPMENT, CANADA, TAR SANDS, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS,
0368 DEVELOPMENT, COMPENSATION, ENVIRONMENTAL EFFECTS, SOCIAL EFFECTS, ENVIRONMENTAL OIL
INDUSTRY, OCS, SCOTLAND,
0372 DEVELOPMENT, DISTRIBUTION, ENVIRONMENTAL EFFECTS, COLORADO,
0019 DISPERSANTS, CLEANUP, BOOMS, OIL SPILLS, POLLUTION CONTROL, USSR, SKIMMERS,
0080 DISPERSANTS, CLEANUP, ACUTE EFFECTS, OIL SPILLS, TANKERS, MARINE ORGANISMS, SPAIN,
*URQUIOLA (TANKER),
0110 DISPERSANTS, CLEANUP, OIL SPILLS, SURFACTANTS,
0111 DISPERSANTS, CLEANUP, OIL SPILLS, SURFACTANTS,
0120 DISPERSANTS, CANADA, BIBLIOGRAPHIES, OIL SPILLS, TOXICITY, REGULATIONS,
0261 DISPERSANTS, CRUDE OIL, BIOLOGICAL EFFECTS, TOXICITY, MOLLUSKS, *RESPIRATION RATE,
0280 DISPERSANTS, CHRONIC EFFECTS, ACUTE EFFECTS, OIL SPILLS, TOXICITY, MARINE ORGANISMS,
0289 DISPERSANTS, BIOLOGICAL EFFECTS, OIL SPILLS, MOLLUSKS, MARINE ORGANISMS, FRANCE,
*NORMAN COAST,
0047 DISPERSANTS, CLEANUP, BIBLIOGRAPHIES, ADSORPTION, OIL SPILLS, RECOVERY, OIL-WATER
SEPARATION, SKIMMERS, FLOTATION,
0101 DISPERSIONS, COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, *SULFUR,
0417 DISPERSIONS, HYDROCARBONS, GROUNDWATER, WATER QUALITY,
0136 DISPOSAL, CLEANUP, CANADA, OIL SPILLS, INCINERATION,
0153 DISPOSAL, CHEMICAL ANALYSIS, *ORGANIC WASTES, WATER QUALITY, SEDIMENTS, SEAWATER,
FRESHWATER, HYDROCARBONS,
0161 DISPOSAL, WASTE OIL TREATMENT, FUEL OIL, *SOLID WASTES, *SEWAGE, INCINERATION,
0162 DISPOSAL, WASTE OIL TREATMENT, LUBRICATING OIL, ENVIRONMENTAL EFFECTS, RECLAMATION,
0165 DISPOSAL, CRUDE OIL, TANKERS, SLUDGE, GUIDELINES,
0189 DISPOSAL, DRILLING, *WASTE MATERIALS,
0210 DISPOSAL, WASTE OIL, RECYCLING, BRINE, GUIDELINES, LEGISLATION,
0024 DISTRIBUTION, DETECTION, MONITORING, TAR, OCEANS,
0061 DISTRIBUTION, MONITORING, TAR, OCEANS, PACIFIC OCEAN,
0327 DISTRIBUTION, CHEMICAL ANALYSIS, SAMPLING, GREAT LAKES, SEDIMENTS, *DREDGED SPOILS,
0372 DISTRIBUTION, DEVELOPMENT, ENVIRONMENTAL EFFECTS, COLORADO,
0386 DISTRIBUTION, CONTAMINANTS, CANADA, SEAFOOD, SEDIMENTS, *NOVA SCOTIA, *HALIFAX HARBOUR,
0387 DISTRIBUTION, BIOLOGICAL EFFECTS, OIL SPILLS, FATE, HYDROCARBONS, *SALT MARSH,
0069 DRIFT, DELAWARE BAY, REMOTE SENSING, ESTUARIES, SPREADING, OIL SLICKS, MODELS, *FRONTS,
0395 DRIFT, MODELS, FATE, OIL SPILLS, *[illegible]-PARCEL-RANDOM-WALK MODEL,
0402 DRIFT, OIL SLICKS, FATE, *WIND-WAVE TUNNEL, *WAVE DAMPING,
0189 DRILLING, DISPOSAL, *WASTE MATERIALS,
0231 DRILLING, BLOWOUT PREVENTION, DESIGN-ENGINEERING, *DROP-IN VALVE,
0262 DRILLING, DETECTION, BLOWOUT PREVENTION, POLLUTION PREVENTION, OIL WELLS,
0288 DRILLING, CONTINGENCY PLANNING, CLEANUP, BOOMS, BLOWOUT PREVENTION, BEAUFORT SEA, OIL
SPILLS, SKIMMERS,
0292 DRILLING, BLOWOUT PREVENTION, POLLUTION PREVENTION, OIL WELLS,
0330 DRILLING, TOXICITY, *FORMATION FLUIDS, PLANTS, *LAND ANIMALS,
0361 DRILLING, CANADA, BEAUFORT SEA, OIL SPILLS, MOVEMENT, *OIL-IN-ICE,
0276 [illegible], BIOLOGICAL EFFECTS, FAO, MARINE ORGANISMS, *OCS DEVELOPMENT,
0334 ECONOMIC EFFECTS, CALIFORNIA, ALASKA, GUIDELINES, WASTEWATER TREATMENT, OFFSHORE
PRODUCTION, MEXICO, GULF OF,
0335 ECONOMIC EFFECTS, ALASKA, OIL INDUSTRY, PRODUCTION,
0337 ECONOMIC EFFECTS, CRUDE OIL, REFINERIES, REGULATIONS, WASTEWATER TREATMENT, OIL
INDUSTRY, *U.S. EPA,
0338 ECONOMIC EFFECTS, CRUDE OIL, REFINERIES, REGULATIONS, WASTEWATER TREATMENT, OIL
INDUSTRY, *U.S. EPA,
0390 ECONOMIC EFFECTS, GUIDELINES, REFINERIES, WASTEWATER TREATMENT, REGULATIONS, *FWPCA,
0422 ECONOMIC EFFECTS, CRUDE OIL, CANADA, REGULATIONS, U.S., *RESOURCE ALLOCATIONS, EIS,
*EEA,

0013 ECONOMICS, CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, INFORMATION SYSTEMS,
  ENVIRONMENTAL PROTECTION, *DATA BASE, *U.S. NAVY,
0125 ECONOMICS, CRUDE OIL, STORAGE, PETROLEUM PRODUCTS, SAFETY, LEAKAGE, *UNDERGROUND SALT
  CAVERNS,
0127 ECONOMICS, OIL TRANSPORT, U.S., STORAGE, TANKERS, PORTS, ENVIRONMENTAL EFFECTS,
0152 ECONOMICS, POLLUTION PREVENTION, WASTEWATER TREATMENT, INDUSTRIES, PETROCHEMICALS,
  SOCIO-ECONOMIC EFFECTS, LEGISLATION,
0158 ECONOMICS, REFINERIES, WASTEWATER TREATMENT, OXIDATION, PETROCHEMICALS,
0174 ECONOMICS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, SKIMMERS,
0212 ECONOMICS, RECYCLING, WASTE OIL, RECOVERY, FUEL OIL, REFINING,
0265 ECONOMICS, BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, FATE, FISHERIES, LAKES,
  VENEZUELA, *LAKE MARACAIBO,
0266 ECONOMICS, BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, FISHERIES, LAKES,
  VENEZUELA, *LAKE MARACAIBO,
0307 ECONOMICS, CLEANUP, FUEL OIL,
0336 ECONOMICS, CALIFORNIA, BIODEGRADATION, MODELS, REFINERIES, OIL SPILLS, *CRUDE OIL
  COSTS,
0339 ECONOMICS, CLEANUP, CANADA, OIL SPILLS, FISHERIES, PORTS, *BAY OF FUNDY,
0362 ECONOMICS, OFFSHORE DRILLING, ENVIRONMENTAL EFFECTS, EIS, *DRILLING VESSELS,
0431 ECONOMICS, INTERNATIONAL AGREEMENTS, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION,
  SHIPS, LEGISLATION, LIABILITY,
0436 ECONOMICS, OIL SPILLS, INSURANCE, LIABILITY, INTERNATIONAL CONVENTIONS, LEGISLATION,
0439 ECONOMICS, BIBLIOGRAPHIES, WASTEWATER TREATMENT, INDUSTRIES, PETROCHEMICALS,
  *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0456 ECONOMICS, BIBLIOGRAPHIES, WASTEWATER TREATMENT, INDUSTRIES, PETROCHEMICALS,
  *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0277 ECOSYSTEMS, CONTAMINATION, CHRONIC EFFECTS, ALASKA, OIL SPILLS, EIS, PIPELINES,
0126 EIS, CRUDE OIL, STORAGE, ENVIRONMENTAL EFFECTS, *SPR, *SALT DOMES,
0277 EIS, ECOSYSTEMS, CONTAMINATION, CHRONIC EFFECTS, ALASKA, OIL SPILLS, PIPELINES,
0362 EIS, ECONOMICS, OFFSHORE DRILLING, ENVIRONMENTAL EFFECTS, *DRILLING VESSELS,
0365 EIS, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING, SANTA BARBARA
  CHANNEL, *U.S.G.S.,
0371 EIS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, OIL SPILLS, PIPELINES, TANKERS,
  OFFSHORE PRODUCTION, SANTA BARBARA CHANNEL,
0482 EIS, ECONOMIC EFFECTS, CRUDE OIL, CANADA, REGULATIONS, U.S., *RESOURCE ALLOCATIONS,
  *SPR,
0523 EIS, CRUDE OIL, LEGISLATION, U.S., STORAGE, OIL TANKS, ENVIRONMENTAL EFFECTS,
0121 EMULSIFICATION, CONTAMINATION, CLEANUP, STORAGE, OIL TANKS, *RESIDUAL OIL,
0253 EMULSIFIERS, CRUDE OIL, BIOLOGICAL EFFECTS, TOXICITY, FISHES,
0296 EMULSIFIERS, BIOLOGICAL EFFECTS, OIL SPILLS, FUEL OIL, MARINE ORGANISMS, INTERTIDAL
  ZONE, MASSACHUSETTS, *WEST FALMOUTH SPILL,
0053 EMULSIONS, REMOTE SENSING, OCEANS, OIL SLICKS, *THERMAL RADIATION, *FLUID FILMS,
0150 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION, *ULTRAFILTRATION,
0151 EMULSIONS, WASTE OIL TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0155 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0156 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, *CATIONIC POLYMERS,
0161 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, PH CONTROL,
0167 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, ULTRAFILTRATION MEMBRANES,
0168 EMULSIONS, WASTEWATER TREATMENT, TANKERS, OIL-WATER SEPARATION, FLOCCULATION,
0173 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0174 EMULSIONS, ECONOMICS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, SKIMMERS,
0176 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0182 EMULSIONS, ADSORPTION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
0187 EMULSIONS, COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0188 EMULSIONS, BILGES, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, SPECTROSCOPY, FUEL
  OIL, LUBRICATING OIL,
0193 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION, INCINERATION, FUEL
  OIL,
0195 EMULSIONS, WASTEWATER TREATMENT, LUBRICATING OIL, OIL-WATER SEPARATION, FLOCCULATION,
  FILTRATION,
0196 EMULSIONS, WASTEWATER TREATMENT, FILTRATION, OIL-WATER SEPARATION,
0205 EMULSIONS, COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
  FILTRATION,
0208 EMULSIONS, WASTE OIL TREATMENT, OIL-WATER SEPARATION,
0209 EMULSIONS, COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0301 ENGLAND, CRUDE OIL, ALGAE, FATE, FAL, HYDROCARBONS, SEDIMENTS, ESTUARIES, *DIATOMS,
0308 ENGLAND, CONTAMINATION, OCEANS, *ADVISORY COMMITTEE ON OIL POLLUTION,
0128 ENVIRONMENTAL DETERIORATION, CHRONIC EFFECTS, OIL TRANSPORT, OIL SPILLS, MARINE
  ORGANISMS,
0320 ENVIRONMENTAL DETERIORATION, OIL SPILLS, TANKERS,
0002 ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DRILLING, OCS, SOCIO-ECONOMIC EFFECTS,
0015 ENVIRONMENTAL EFFECTS, BIRDS, OIL SPILLS, FUEL OIL, SCOTLAND, *SANDS OF FORVIE,
0017 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, HYDROCARBONS, FATE, *SYMPOSIUM,

0025 ENVIRONMENTAL EFFECTS, MONITORING, REFINERIES, PETROCHEMICALS, VENEZUELA, *BASELINE STUDIES,
0038 ENVIRONMENTAL EFFECTS, MONITORING, *BASELINE STUDIES, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, CHERRY POINT REFINERY,
0039 ENVIRONMENTAL EFFECTS, MONITORING, *BASELINE STUDIES, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, *CHERRY POINT REFINERY,
0040 ENVIRONMENTAL EFFECTS, MONITORING, *BASELINE STUDIES, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, *CHERRY POINT REFINERY,
0068 ENVIRONMENTAL EFFECTS, CANADA, ANALYTICAL TECHNIQUES, HYDROCARBONS, SEAWATER, SPECTROSCOPY, REFINERIES, *COME-BY-CHANCE BAY,
0127 ENVIRONMENTAL EFFECTS, ECONOMICS, OIL TRANSPORT, U.S., STORAGE, TANKERS, PORTS,
0135 ENVIRONMENTAL EFFECTS, OIL TRANSFER, *OIL TERMINAL, SCOTLAND, *SULLOM VOE,
0136 ENVIRONMENTAL EFFECTS, EIS, CRUDE OIL, STORAGE, *FEA, *SALT DOMES,
0137 ENVIRONMENTAL EFFECTS, CRUDE OIL, STORAGE, *FEA, *SALT DOMES,
0160 ENVIRONMENTAL EFFECTS, DISPOSAL, WASTE OIL TREATMENT, LUBRICATING OIL, RECLAMATION,
0161 ENVIRONMENTAL EFFECTS, WASTEWATER DISPOSAL, OIL FIELDS, REFINERIES, OIL INDUSTRY,
0222 ENVIRONMENTAL EFFECTS, WASTE OIL, FRESHWATER, SEAWATER, RECLAMATION, RECYCLING, UK,
0258 ENVIRONMENTAL EFFECTS, ACUTE EFFECTS, OIL SPILLS,
0296 ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, PRODUCTION, *OIL POLLUTION,
0309 ENVIRONMENTAL EFFECTS, COASTS, OIL SPILLS, INDONESIA, OFFSHORE DRILLING,
0312 ENVIRONMENTAL EFFECTS, CANADA, ARCTIC, WATER QUALITY, OIL SPILLS,
0313 ENVIRONMENTAL EFFECTS, CONTAMINATION, OCEANS, HYDROCARBONS, *MARINE POLLUTANTS,
0317 ENVIRONMENTAL EFFECTS, ENGLAND, ATLANTIC COAST, OIL SPILLS, HEALTH HAZARDS, AROMATIC HYDROCARBONS, OFFSHORE EXPLORATION, *NEW
0318 ENVIRONMENTAL EFFECTS, CRUDE OIL, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES, MARINE ORGANISMS, OIL SPILLS, FATE, OCEANS,
0319 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, HYDROCARBONS, WASTEWATERS, *1,3-BUTADIENE,
0322 ENVIRONMENTAL EFFECTS, CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, TANKERS, POLLUTION CONTROL, INTERNATIONAL CONVENTIONS,
0325 ENVIRONMENTAL EFFECTS, CHEDABUCTO BAY, CANADA, BIODEGRADATION, FUEL OIL, OIL SPILLS, SHORELINES, MARINE ORGANISMS,
0327 ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, OCS, OFFSHORE DEVELOPMENT, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL MANAGEMENT,
0352 ENVIRONMENTAL EFFECTS, EIS, ECONOMICS, OFFSHORE DRILLING, *DRILLING VESSELS,
0355 ENVIRONMENTAL EFFECTS, ALASKA, OFFSHORE DEVELOPMENT, OCS, U.S. GOVERNMENT,
0356 ENVIRONMENTAL EFFECTS, OIL INDUSTRY, OIL SPILLS, PRODUCTION, SCOTLAND, *SHETLAND ISLANDS, *SULLOM VOE,
0358 ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, GROUNDWATER, *STREAMS,
0359 ENVIRONMENTAL EFFECTS, TAR SANDS, EXTRACTION, PRODUCTION, WASTEWATER DISPOSAL,
0360 ENVIRONMENTAL EFFECTS, DEVELOPMENT, CANADA, TAR SANDS, SOCIO-ECONOMIC EFFECTS,
0361 ENVIRONMENTAL EFFECTS, COASTS, SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, FLORIDA, GUIDELINES, *ONSHORE EFFECTS,
0363 ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DEVELOPMENT, OCS, *ONSHORE IMPACTS, SOCIO-ECONOMIC EFFECTS,
0364 ENVIRONMENTAL EFFECTS, ATLANTIC COAST, ALASKA/GULF OF, *ONSHORE EFFECTS, OFFSHORE PRODUCTION, OCS,
0365 ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, PRODUCTION, EXTRACTION,
0367 ENVIRONMENTAL EFFECTS, COASTS, OCS, OFFSHORE DEVELOPMENT, OFFSHORE PRODUCTION, OIL INDUSTRY, FISHERIES, SCOTLAND,
0368 ENVIRONMENTAL EFFECTS, DEVELOPMENT, CONSERVATION, SOCIAL EFFECTS, ENVIRONMENTAL OIL INDUSTRY, OCS, SCOTLAND,
0369 ENVIRONMENTAL EFFECTS, EIS, OFFSHORE DEVELOPMENT, OCS, OIL-GAS LEASING, SANTA BARBARA CHANNEL, *U.S.G.S.,
0370 ENVIRONMENTAL EFFECTS, OIL TRANSFER, OIL TRANSPORT, PIPELINES, TANKERS,
0371 ENVIRONMENTAL EFFECTS, EIS, SOCIO-ECONOMIC EFFECTS, OIL SPILLS, PIPELINES, TANKERS, OFFSHORE PRODUCTION, SANTA BARBARA CHANNEL,
0372 ENVIRONMENTAL EFFECTS, DISTRIBUTION DEVELOPMENT, COLORADO,
0373 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS,
0409 ENVIRONMENTAL EFFECTS, DECOMPOSITION, CRUDE OIL, BIOLOGICAL EFFECTS, ARCTIC, FATE,
0423 ENVIRONMENTAL EFFECTS, EIS, CRUDE OIL, LEGISLATION, U.S., STORAGE, OIL TANKS,
0430 ENVIRONMENTAL EFFECTS, CONTAMINATION, INTERNATIONAL CONVENTIONS, OIL SPILLS, OCEANS, *OCEANS,
0441 ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, OIL SPILLS,
0442 ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, OFFSHORE DRILLING, OIL WELLS,
0443 ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, TANKERS, PORTS, *SUPERTANKERS, *DEEPWATER PORTS,
0444 ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, TANKERS, PORTS, *SUPERTANKERS, *DEEPWATER PORTS,
0445 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BIBLIOGRAPHIES, OIL SPILLS, TOXICITY, MARINE ORGANISMS,
0446 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BIODEGRADATION, BIBLIOGRAPHIES, OIL SPILLS, MARINE ORGANISMS, *TROPICAL WATERS,
0327 ENVIRONMENTAL MANAGEMENT, ENVIRONMENTAL EFFECTS, BIBLIOGRAPHIES, OCS, OFFSHORE DEVELOPMENT, SOCIO-ECONOMIC EFFECTS,
0732 ENVIRONMENTAL MANAGEMENT, OIL SPILLS, SOCIAL EFFECTS,
0013 ENVIRONMENTAL PROTECTION, ECONOMICS, CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, INFORMATION SYSTEMS, *DATA BASE, *U.S. NAVY,

0066 ENVIRONMENTAL PROTECTION, REMOTE SENSING, OIL SPILLS, POLLUTION CONTROL,
0136 ENVIRONMENTAL PROTECTION, OCEANS, OIL SPILLS, OIL DISCHARGES, INTERNATIONAL
CONVENTIONS, WASTEWATERS, *IMCO,
0150 ENVIRONMENTAL PROTECTION, WASTEWATER TREATMENT, WASTEWATER DISPOSAL, WASTE OIL, SHIPS,
0207 ENVIRONMENTAL PROTECTION, COASTS, OIL SPILLS, LOUISIANA, PORTS,
0262 ENVIRONMENTAL PROTECTION, INTERNATIONAL CONVENTIONS, POLLUTION CONTROL, OIL
DISCHARGES, MEDITERRANEAN SEA,
0273 ENVIRONMENTAL PROTECTION, CARIBBEAN SEA, POLLUTION CONTROL, REFINERIES,
0316 ENVIRONMENTAL PROTECTION, CONTAMINATION, MARINE ORGANISMS, GUIDELINES,
0350 ENVIRONMENTAL PROTECTION, OIL INDUSTRY, *EXXON, OFFSHORE PRODUCTION, OIL SPILLS,
TANKERS,
0352 ENVIRONMENTAL PROTECTION, COASTS, OIL SPILLS, OFFSHORE DEVELOPMENT, OCS,
SOCIO-ECONOMIC EFFECTS,
0353 ENVIRONMENTAL PROTECTION, OIL SHALE DEVELOPMENT, ENVIRONMENTAL MANAGEMENT, EXTRACTION,
0355 ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT, GOVERNMENT AGENCIES,
*U.S.G.S.,
0356 ENVIRONMENTAL PROTECTION, DELAWARE, LEGISLATION, U.S., OFFSHORE DEVELOPMENT, OCS,
LIABILITY, OIL SPILLS,
0357 ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT, GOVERNMENT AGENCIES,
*U.S. EPA,
0358 ENVIRONMENTAL PROTECTION, AUSTRALIA, OFFSHORE DEVELOPMENT, SAFETY, OFFSHORE PRODUCTION,
0359 ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT, GOVERNMENT AGENCIES,
*U.S. BUREAU LAND MANAGEMENT,
0372 ENVIRONMENTAL PROTECTION, OIL SHALE DEVELOPMENT, WASTEWATERS, POLLUTION CONTROL,
GOVERNMENT AGENCIES, *U.S. EPA,
0417 ENVIRONMENTAL PROTECTION, LEGISLATION, STATE GOVERNMENTS, OFFSHORE DEVELOPMENT, PORTS,
NORTH CAROLINA,
0426 ENVIRONMENTAL PROTECTION, LEGISLATION, POLLUTION PREVENTION, LIABILITY,
0133 ENVIRONMENTAL PROTECTION, BALTIC SEA, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION,
OIL DISCHARGES, SHIPS,
0006 ESTUARIES, BIRDS, RIVERS, OIL SLICKS, UK, SOURCE IDENTIFICATION,
0049 ESTUARIES, DRIFT, DELAWARE BAY, REMOTE SENSING, SPREADING, OIL SLICKS, MODELS, *REPORTS,
0062 ESTUARIES, ANALYTICAL TECHNIQUES, HYDROCARBONS, SPECTROSCOPY, MICROORGANISMS, NORTH
CAROLINA,
0064 ESTUARIES, CARCINOGENS, CALIFORNIA, ALGAE, HYDROCARBONS, SAN FRANCISCO BAY, TAR, FUEL
OIL,
0161 ESTUARIES, ENGLAND, CRUDE OIL, ALGAE, FATE, TAR, HYDROCARBONS, SEDIMENTS, *DIATOMS,
0124 ESTUARIES, BIODEGRADATION, HYDROCARBONS, TOXICITY, WATER QUALITY, FRESHWATER,
SEAWATER, *U.S. EPA,
0201 ESTUARIES, MODELS, OIL DISCHARGES, FATE,
0363 EUROPE, OFFSHORE DEVELOPMENT, OFFSHORE DRILLING, OIL TRANSPORT, REGULATIONS, OIL
SPILLS,
0428 EUROPE, CLEANUP, LEGISLATION, INTERNATIONAL AGREEMENTS, POLLUTION PREVENTION, OCEANS,
OFFSHORE PRODUCTION, OIL DISCHARGES,
0098 EVAPORATION, DECOMPOSITION, CRUDE OIL, CLEANUP, OIL SPILLS, *LAKES,
0301 EVAPORATION, ADSORPTION, SEDIMENTATION, HYDROCARBONS, OIL SLICKS, *NERITICAL
ENVIRONMENTS,
0391 EVAPORATION, BIOLOGICAL EFFECTS, BEHAVIOR, OIL SPILLS, *FREEZING CONDITIONS, MARINE
ORGANISMS,
0296 EVAPORATION, BEHAVIOR, OIL SLICKS, WEATHERING, SPREADING, TAR,
0012 EVAPORATION, CRUDE OIL, BIODEGRADATION, FATE, OCEANS, WEATHERING,
0080 EXTRACTION, ANALYTICAL TECHNIQUES, OIL SPILLS, SAMPLING, *FLUORESCENCE, [illegible]
SOURCE IDENTIFICATION,
0155 EXTRACTION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, HYDROCARBONS, *SOLVENT
0365 EXTRACTION, ENVIRONMENTAL EFFECTS, TAR SANDS, PRODUCTION, WASTEWATER DISPOSAL,
0353 EXTRACTION, ENVIRONMENTAL PROTECTION, OIL SHALE DEVELOPMENT, ENVIRONMENTAL MANAGEMENT,
0366 EXTRACTION, ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, PRODUCTION,
0017 FATE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, HYDROCARBONS, *SYMPOSIUM,
0259 FATE, CRUSTACEANS, HYDROCARBONS, MARINE ORGANISMS, FUEL OIL, FISHES, MOLLUSKS,
*ACCUMULATION AND RELEASE STUDIES,
0265 FATE, ECONOMICS, BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, FISHERIES, LAKES,
VENEZUELA, *LAKE MARACAIBO,
0281 FATE, CRUSTACEANS, HYDROCARBONS, METABOLISM, *BLUE CRAB,
0293 FATE, BIOLOGICAL EFFECTS, HYDROCARBONS, POLYCHAETES, *NEANTHES ARENACEODENTATA,
0307 FATE, METABOLISM, HYDROCARBONS, MONITORING, MOLLUSKS, *OYSTERS, *CRASSOSTREA VIRGINICA,
0161 FATE, ESTUARIES, ENGLAND, CRUDE OIL, ALGAE, TAR, HYDROCARBONS, SEDIMENTS, *DIATOMS,
0316 FATE, CLEANUP, BIOLOGICAL EFFECTS, BEHAVIOR, OIL SPILLS, NORTH SEA,
0318 FATE, ENVIRONMENTAL EFFECTS, CRUDE OIL, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES,
MARINE ORGANISMS, OIL SPILLS, OCEANS,
0332 FATE, CANADA, BEHAVIOR, BEACHES, OIL SPILLS, SEDIMENTS, *NOVA SCOTIA,
0353 FATE, HYDROCARBONS, OIL SLICKS, WEATHERING, SEDIMENTATION,
0396 FATE, DRIFT, MODELS, OIL SPILLS, *DISCRETE-PARCEL-RANDOM-WALK MODEL,
0397 FATE, DISTRIBUTION, BIOLOGICAL EFFECTS, OIL SPILLS, HYDROCARBONS, *SALT MARSH,
0398 FATE, HYDROCARBONS, METABOLISM, FOOD WEB, MARINE ORGANISMS, MICROORGANISMS,
0399 FATE, CRUDE OIL, COASTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, BEACHES, INDIA, *TAR BALLS,

0801 FATE, BIODEGRADATION, MOVEMENT, HYDROCARBONS, MARINE ORGANISMS, *CHEMORECEPTION,
0802 FATE, DRIFT, OIL SLICKS, *WIND-WAVE TUNNEL, *WAVE DAMPING,
0803 FATE, EVAPORATION, CRUDE OIL, BIODEGRADATION, OCEANS, WEATHERING,
0804 FATE, METABOLISM, HYDROCARBONS, PHYTOPLANKTON, ZOOPLANKTON, FISHES, INVERTEBRATES,
0805 FATE, ESTUARIES, MODELS, OIL DISCHARGES,
0806 FATE, OIL SPILLS, HYDROCARBONS, DISPERSION, GROUNDWATER,
0808 FATE, CONTAMINATION, ALASKA/GULF OF, OFFSHORE DEVELOPMENT, *SEISMICITY, *GROUND SHAKING,
0809 FATE, ENVIRONMENTAL EFFECTS, DECOMPOSITION, CRUDE OIL, BIOLOGICAL EFFECTS, ARCTIC,
0812 FATE, HYDROCARBONS, PAH, OCEANS, SOURCE IDENTIFICATION, PLANTS, OIL SPILLS,
0814 FATE, CHRONIC EFFECTS, CHEDABUCTO BAY, CANADA, BEACHES, FUEL OIL, SEDIMENTS, *WATER COLUMN, MARINE ORGANISMS,
0815 FATE, BIBLIOGRAPHIES, OIL SPILLS, OCEANS, *PHYSICAL CHANGES, *CHEMICAL CHANGES,
0180 FILTRATION, EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, *ULTRAFILTRATION,
0163 FILTRATION, ADSORPTION, WASTEWATER TREATMENT, PETROCHEMICALS, OIL INDUSTRY, OIL-WATER SEPARATION, OXIDATION, INCINERATION, FLOTATION,
0186 FILTRATION, WASTEWATER TREATMENT, PETROLEUM PRODUCTS, OXIDATION,
0193 FILTRATION, EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, INCINERATION, FUEL OIL,
0195 FILTRATION, EMULSIONS, WASTEWATER TREATMENT, LUBRICATING OIL, OIL-WATER SEPARATION, FLOCCULATION,
0196 FILTRATION, EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0205 FILTRATION, EMULSIONS, COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
0206 FILTRATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, PH CONTROL,
0053 FISHES, CRUSTACEANS, BIODEGRADATION, BALTIC SEA, BACTERIA, MONITORING, HYDROCARBONS,
0076 FISHES, CONTAMINATION, CHROMATOGRAPHY, CHEMICAL ANALYSIS, PAH,
0259 FISHES, FATE, CRUSTACEANS, HYDROCARBONS, MARINE ORGANISMS, FUEL OIL, MOLLUSKS, *ACCUMULATION AND RELEASE STUDIES,
0281 FISHES, CRUSTACEANS, CRUDE OIL, CHEMICAL ANALYSIS, HYDROCARBONS, TOXICITY,
0282 FISHES, TOXICITY, FUELS, FRESHWATER, *JET ENGINE FUELS,
0283 FISHES, EMULSIFIERS, CRUDE OIL, BIOLOGICAL EFFECTS, TOXICITY,
0285 FISHES, BIOLOGICAL EFFECTS, ALGAE, HYDROCARBONS, INVERTEBRATES, *PHYSIOLOGICAL EFFECTS, *BIOCHEMICAL EFFECTS,
0306 FISHES, BIOLOGICAL EFFECTS, HYDROCARBONS, TOXICITY, METABOLISM,
0804 FISHES, FATE, METABOLISM, HYDROCARBONS, PHYTOPLANKTON, ZOOPLANKTON, INVERTEBRATES,
0260 FISHERIES, BIRDS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, SCOTLAND, *CONFERENCE,
0265 FISHERIES, FATE, ECONOMICS, BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, LAKES, VENEZUELA, *LAKE MARACAIBO,
0298 FISHERIES, ECONOMICS, BIOLOGICAL EFFECTS, OIL DISCHARGES, WASTEWATERS, LAKES, VENEZUELA, *LAKE MARACAIBO,
0303 FISHERIES, CRUDE OIL, BIOLOGICAL EFFECTS, OFFSHORE PRODUCTION, TOXICITY, LOUISIANA,
0339 FISHERIES, ECONOMICS, CLEANUP, CANADA, OIL SPILLS, PORTS, *BAY OF FUNDY,
0367 FISHERIES, ENVIRONMENTAL EFFECTS, COASTS, OCS, OFFSHORE DEVELOPMENT, OFFSHORE PRODUCTION, OIL INDUSTRY, SCOTLAND,
0161 FLOCCULATION, EMULSIONS, WASTEWATER TREATMENT, TANKERS, OIL-WATER SEPARATION,
0169 FLOCCULATION, CONTAMINANTS, WASTEWATER TREATMENT, INDUSTRIES, *POLYELECTROLYTES,
0182 FLOCCULATION, EMULSIONS, ADSORPTION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0192 FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, PH CONTROL, SEDIMENTATION,
0195 FLOCCULATION, FILTRATION, EMULSIONS, WASTEWATER TREATMENT, LUBRICATING OIL, OIL-WATER SEPARATION,
0197 FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, OXIDATION, PH CONTROL, FLOTATION,
0198 FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, OIL-WATER SEPARATION, PH CONTROL, OXIDATION,
0205 FLOCCULATION, FILTRATION, EMULSIONS, COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
0009 FLORIDA, OIL SPILLS, SOURCE IDENTIFICATION, TANKERS, *U.S. COAST GUARD,
0361 FLORIDA, ENVIRONMENTAL EFFECTS, COASTS, SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, GUIDELINES, *ONSHORE EFFECTS,
0163 FLOTATION, FILTRATION, ADSORPTION, WASTEWATER TREATMENT, PETROCHEMICALS, OIL INDUSTRY, OIL-WATER SEPARATION, OXIDATION, INCINERATION,
0197 FLOTATION, FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, OXIDATION, PH CONTROL,
0887 FLOTATION, DISPERSANTS, CLEANUP, BIBLIOGRAPHIES, ADSORPTION, OIL SPILLS, RECOVERY, OIL-WATER SEPARATION, SKIMMERS,
0064 FOOD WEB, ESTUARIES, CARCINOGENS, CALIFORNIA, ALGAE, HYDROCARBONS, SAN FRANCISCO BAY, PAH,
0308 FOOD WEB, FATE, HYDROCARBONS, METABOLISM, MARINE ORGANISMS, MICROORGANISMS,
0289 FRANCE, DISPERSANTS, BIOLOGICAL EFFECTS, OIL SPILLS, MOLLUSKS, MARINE ORGANISMS, *NORMAN COAST,
0153 FRESHWATER, DISPOSAL, CHEMICAL ANALYSIS, *ORGANIC WASTES, WATER QUALITY, SEDIMENTS, SEAWATER, HYDROCARBONS,
0221 FRESHWATER, ENVIRONMENTAL EFFECTS, WASTE OIL, SEAWATER, RECLAMATION, RECYCLING, UK,
0282 FRESHWATER, FISHES, TOXICITY, FUELS, *JET ENGINE FUELS,
0292 FRESHWATER, CRUDE OIL, CONTAMINATION, CANADA, BIOLOGICAL EFFECTS, PETROLEUM PRODUCTS, *CHIRONOMIDAE,

0295 FRESHWATER, CANADA, BIOLOGICAL EFFECTS, BACTERIA, ALGAE, OIL SPILLS,
0321 FRESHWATER, CRUDE OIL, *PARTITIONING STUDIES, *MERCURY, *PCB, SEDIMENTS, SEAWATER,
0324 FRESHWATER, ESTUARIES, BIODEGRADATION, HYDROCARBONS, TOXICITY, WATER QUALITY,
SEAWATER, *U.S. EPA,
0006 FUEL OIL, CRUDE OIL, CANADA, OIL SPILLS, INLAND, U.S.,
0007 FUEL OIL, CHESAPEAKE BAY, BIRDS, BEACHES, OIL SPILLS, MARINE ORGANISMS, *OIL BARGE,
0016 FUEL OIL, ENVIRONMENTAL EFFECTS, BIRDS, OIL SPILLS, SCOTLAND, *SANDS OF FORVIE,
0086 FUEL OIL, CONTAMINANTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION,
GASOLINE, *FLUORESCENCE,
0161 FUEL OIL, DISPOSAL, WASTE OIL TREATMENT, *SOLID WASTES, *SEWAGE, INCINERATION,
0188 FUEL OIL, EMULSIONS, BILGES, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT,
SPECTROSCOPY, LUBRICATING OIL,
0193 FUEL OIL, FILTRATION, EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
INCINERATION,
0213 FUEL OIL, CRANKCASE OIL, RECLAMATION, WASTE OIL, LUBRICATING OIL,
0214 FUEL OIL, WASTE OIL TREATMENT, RECYCLING, LUBRICATING OIL, LEGISLATION, U.S.,
0216 FUEL OIL, ECONOMICS, RECYCLING, WASTE OIL, RECOVERY, REFINING,
0268 FUEL OIL, FISHES, FATE, CRUSTACEANS, HYDROCARBONS, MARINE ORGANISMS, MOLLUSKS,
*ACCUMULATION AND RELEASE STUDIES,
0270 FUEL OIL, BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, SCOTLAND, POLLUTION CONTROL, *RIVER
YTHAN,
0276 FUEL OIL, CRUSTACEANS, CRUDE OIL, CHRONIC EFFECTS, ACUTE EFFECTS, TOXICITY,
METABOLISM, *MUD CRAB,
0279 FUEL OIL, BIOLOGICAL EFFECTS, OIL SPILLS, METABOLISM, MOLLUSKS, *MYA ARENARIA, *CARBON
FLUX,
0298 FUEL OIL, EMULSIFIERS, BIOLOGICAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, INTERTIDAL
ZONE, MASSACHUSETTS, *WEST FALMOUTH SPILL,
0307 FUEL OIL, ECONOMICS, CLEANUP,
0325 FUEL OIL, ENVIRONMENTAL EFFECTS, CHEDABUCTO BAY, CANADA, BIODEGRADATION, OIL SPILLS,
SHORELINES, MARINE ORGANISMS,
0364 FUEL OIL, CRUDE OIL, CRANKCASE OIL, BIODEGRADATION, BACTERIA, METABOLISM, SOIL,
0614 FUEL OIL, FATE, CHRONIC EFFECTS, CHEDABUCTO BAY, CANADA, BEACHES, SEDIMENTS, *WATER
COLUMN, MARINE ORGANISMS,
0032 FUELS, CONTAINMENT, ARCTIC, PETROLEUM PRODUCTS, STORAGE, *SPILL CONTAINMENT DIKES,
0117 FUELS, CLEANUP, *FUEL SPILLS, *NEUTRALIZATION,
0200 FUELS, BILGES, TANKERS, WASTEWATER TREATMENT, *CHARACTERIZATION STUDIES,
0215 FUELS, RECLAMATION, REUSE, WASTE OIL, LUBRICATING OIL,
0282 FUELS, FRESHWATER, FISHES, TOXICITY, *JET ENGINE FUELS,
0279 FUNGI, BIODEGRADATION, METABOLISM, HYDROCARBONS, YEASTS,
0355 FUNGI, BIODEGRADATION, BIBLIOGRAPHIES, HYDROCARBONS, METABOLISM, MICROORGANISMS,
0059 GASOLINE, CHROMATOGRAPHY, CHEMICAL ANALYSIS, TAR, PETROLEUM PRODUCTS,
0086 GASOLINE, FUEL OIL, CONTAMINANTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE
IDENTIFICATION, *FLUORESCENCE,
0283 GASOLINE, BIOLOGICAL EFFECTS, BENTHOS, HYDROCARBONS, PHYTOPLANKTON, ZOOPLANKTON, WATER
QUALITY, *MARINE ENGINE EMISSIONS,
0236 GERMANY, WEST, COASTS, GOVERNMENT AGENCIES, POLLUTION PREVENTION, OIL SPILLS, OCEANS,
0229 GOVERNMENT AGENCIES, CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, POLLUTION PREVENTION,
TANKERS, *U.S.C.G.,
0231 GOVERNMENT AGENCIES, CONTINGENCY PLANNING, CANADA, BEAUFORT SEA, OIL SPILLS, OIL
INDUSTRY,
0236 GOVERNMENT AGENCIES, GERMANY, WEST, COASTS, POLLUTION PREVENTION, OIL SPILLS, OCEANS,
0244 GOVERNMENT AGENCIES, CANADA, POLLUTION PREVENTION, OIL SPILLS, INDUSTRIES,
LEGISLATION, PERSONNEL TRAINING,
0254 GOVERNMENT AGENCIES, CLEANUP, CANADA, BIRDS, OIL SPILLS, ST. LAWRENCE RIVER, L.S.L.,
RESTORATION,
0356 GOVERNMENT AGENCIES, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT,
*U.S.G.S.,
0357 GOVERNMENT AGENCIES, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT,
*U.S. EPA,
0358 GOVERNMENT AGENCIES, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, OFFSHORE DEVELOPMENT,
*U.S. BUREAU-LAND MANAGEMENT,
0362 GOVERNMENT AGENCIES, ENVIRONMENTAL PROTECTION, OIL SHALE DEVELOPMENT, WASTEWATERS,
POLLUTION CONTROL, *U.S. EPA,
0366 GOVERNMENT AGENCIES, OCS, OFFSHORE DRILLING, PRODUCTION, REGULATIONS, *U.S.G.S.,
0296 GROUNDWATER, ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, *STREAMS,
0006 GROUNDWATER, FATE, OIL SPILLS, HYDROCARBONS, DISPERSION,
0007 GROUNDWATER, DISPERSIONS, HYDROCARBONS, WATER QUALITY,
0181 GUIDELINES, TANKERS, SLUDGE, DISPOSAL, CRUDE OIL,
0210 GUIDELINES, WASTE OIL, DISPOSAL, RECYCLING, REUSE, LEGISLATION,
0316 GUIDELINES, ENVIRONMENTAL PROTECTION, CONTAMINATION, MARINE ORGANISMS,
0336 GUIDELINES, ECONOMIC EFFECTS, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, ALASKA,
MEXICO/GULF OF, CALIFORNIA,
0345 GUIDELINES, ECONOMIC EFFECTS, REFINERIES, WASTEWATER TREATMENT, REGULATIONS, *FWPCA,
0361 GUIDELINES, ENVIRONMENTAL EFFECTS, SOCIOECONOMIC EFFECTS, OFFSHORE DEVELOPMENT,
COASTS, FLORIDA, *ONSHORE EFFECTS,

[illegible] GUIDELINES, MANUALS, OIL SPILLS, POLLUTION PREVENTION, CONTAINMENT, CLEANUP,
[illegible] GUIDELINES, WASTEWATER TREATMENT, REGULATIONS, OFFSHORE DRILLING, PRODUCTION,
[illegible] GUIDELINES, REGULATIONS, OFFSHORE PRODUCTION, OIL DISCHARGES, POLLUTION CONTROL, *U.S. EPA
[illegible] HARBORS, REMOTE SENSING, RIVERS, MARYLAND, WASTEWATERS, OIL DISCHARGES, WATER QUALITY,
[illegible] HARBORS, BIODEGRADATION, CONTAMINANTS, METABOLISM, BACTERIA, CHESAPEAKE BAY, *MERCURY
INHIBITION,
[illegible] HEALTH HAZARDS, TAR, CONTAMINATION, *BEACHES, CARCINOGENS,
[illegible] HEALTH HAZARDS, OIL SPILLS, ENVIRONMENTAL EFFECTS, AROMATIC HYDROCARBONS, OFFSHORE
EXPLORATION, ATLANTIC COAST, *NEW ENGLAND,
[illegible] HYDROCARBONS, CONTAMINATION, MEDITERRANEAN SEA, OIL DISCHARGES, TANKERS, REFINERIES,
[illegible] HYDROCARBONS, BIOLOGICAL EFFECTS, FATE, ENVIRONMENTAL EFFECTS, *SYMPOSIUM,
[illegible] HYDROCARBONS, MONITORING, FILTERS, BALLAST, DESIGN-ENGINEERING, *FLUORESCENCE,
*OIL-IN-WATER,
[illegible] HYDROCARBONS, MONITORING, SAMPLING, STORAGE,
[illegible] HYDROCARBONS, MONITORING, BEACHES, NEW JERSEY,
[illegible] HYDROCARBONS, MONITORING, DETECTION, MOLLUSKS, BALTIC SEA, *BLUE MUSSEL, *KIEL BIGHT,
[illegible] HYDROCARBONS, MONITORING, BEACHES, MEXICO GULF OF, CHEMICAL ANALYSIS,
[illegible] HYDROCARBONS, MONITORING, BALTIC SEA, CRUSTACEANS, FISHES, BIODEGRADATION, BACTERIA,
[illegible] HYDROCARBONS, SAMPLING, MOLLUSKS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, ADRIATIC SEA,
*MUSSELS, *GULF OF [illegible],
[illegible] HYDROCARBONS, SAMPLING, DETECTION, SOLUBILITY, SEAWATER,
[illegible] HYDROCARBONS, OIL SPILLS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, *LUMINESCENCE,
[illegible] HYDROCARBONS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, MICROORGANISMS, ESTUARIES, NORTH
CAROLINA,
[illegible] HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, BIRDS, *SUBANTARCTIC PELAGIC BIRDS,
*STOMACH OIL, MONITORING,
[illegible] HYDROCARBONS, ALGAE, SAN FRANCISCO BAY, CARCINOGENS, TAR, ESTUARIES, FOOD WEB,
CALIFORNIA,
[illegible] HYDROCARBONS, SEAWATER, ANALYTICAL TECHNIQUES, SPECTROSCOPY, REFINERIES, CANADA,
ENVIRONMENTAL EFFECTS, *[illegible] BAY,
[illegible] HYDROCARBONS, DETECTION, SAMPLING, CHEMICAL ANALYSIS, DESIGN-ENGINEERING,
[illegible] HYDROCARBONS, ANALYTICAL TECHNIQUES, CONTAMINANTS, *AIR QUALITY, WATER QUALITY,
[illegible] HYDROCARBONS, SAMPLING, CHEMICAL ANALYSIS, SEAWATER, *SURFACE MICROLAYER,
[illegible] HYDROCARBONS, RECOVERY, ADSORPTION, OIL-WATER SEPARATION, *OLEOPHILIC MATERIAL,
[illegible] HYDROCARBONS, [illegible], *[illegible] WASTES, WATER QUALITY, CHEMICAL ANALYSIS, SEDIMENTS,
[illegible],
[illegible] HYDROCARBONS, WASTEWATER TREATMENT, [illegible], *SOLVENT EXTRACTION,
[illegible] HYDROCARBONS, WASTEWATER TREATMENT, REFINERIES, PETROLEUM PRODUCTS,
[illegible] HYDROCARBONS, POLLUTION PREVENTION, [illegible], MEDITERRANEAN SEA
[illegible] HYDROCARBONS, POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS,
[illegible] HYDROCARBONS, BIOLOGICAL EFFECTS, MARINE ORGANISMS,
[illegible] HYDROCARBONS, MOLLUSKS, MARINE ORGANISMS, *UPTAKE AND DEPURATION,
[illegible] HYDROCARBONS, FATE, MARINE ORGANISMS, [illegible], FISHES, MOLLUSKS, CRUSTACEANS,
*ACCUMULATION [illegible],
[illegible] HYDROCARBONS, [illegible], FISHES, CRUSTACEANS, CHEMICAL ANALYSIS,
[illegible] HYDROCARBONS, [illegible], MOLLUSKS, SEDIMENTS, NORTH SEA, *OYSTERS,
[illegible] HYDROCARBONS, [illegible] EFFECTS, PHYTOPLANKTON, ZOOPLANKTON, BENTHOS, WATER QUALITY,
[illegible], *MARINE [illegible],
[illegible] HYDROCARBONS, [illegible], METABOLISM,
[illegible] HYDROCARBONS, FATE, [illegible], CRUSTACEANS, *[illegible],
[illegible] HYDROCARBONS, BIOLOGICAL EFFECTS, FISHES, ALGAE, INVERTEBRATES, *PHYSIOLOGICAL
[illegible], *[illegible],
[illegible] HYDROCARBONS, [illegible], CRUSTACEANS, MOLLUSKS, *EMULSION, *OIL POLLUTION,
[illegible] HYDROCARBONS, [illegible] EFFECTS, FATE, *[illegible],
[illegible] HYDROCARBONS, [illegible], *[illegible] GRASS SHRIMP, *PALAEMONETES PUGIO,
[illegible] HYDROCARBONS, METABOLISM, [illegible], FATE, MOLLUSKS, *OYSTERS, *CRASSOSTREA VIRGINICA,
[illegible] HYDROCARBONS, FATE, [illegible], ALGAE, SEDIMENTS, ESTUARIES, ENGLAND, *DIATOMS,
[illegible] HYDROCARBONS, BIOLOGICAL EFFECTS, [illegible], ALGAE, *NAPHTHALENE, *ALGAL PHYSIOLOGY,
[illegible] HYDROCARBONS, [illegible], METABOLISM,
[illegible] HYDROCARBONS, CONTAMINATION, OCEANS, *MARINE POLLUTANTS, ENVIRONMENTAL EFFECTS,
[illegible] HYDROCARBONS, HEALTH HAZARDS, OIL SPILLS, ENVIRONMENTAL EFFECTS, OFFSHORE
EXPLORATION, ATLANTIC COAST, *NEW ENGLAND,
[illegible] HYDROCARBONS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, WASTEWATERS, *1,3-BUTADIENE,
[illegible] HYDROCARBONS, [illegible], BIODEGRADATION, WATER QUALITY, ESTUARIES, FRESHWATER,
SEAWATER, *[illegible],
[illegible] HYDROCARBONS, [illegible] EFFECTS, SEDIMENTS, OIL FIELDS, MICROORGANISMS, LOUISIANA,
*PETROLEUM [illegible],
[illegible] HYDROCARBONS, MARINE [illegible], PRUDHOE BAY, ALASKA,
[illegible] HYDROCARBONS, BIODEGRADATION, METABOLISM, FUNGI, YEASTS,
[illegible] HYDROCARBONS, BIODEGRADATION, [illegible], *PHOSPHORUS REQUIREMENTS,
[illegible] HYDROCARBONS, BIODEGRADATION, [illegible], OIL SPILLS, *CELLULOSIC SUBSTRATES,
[illegible] HYDROCARBONS, BIODEGRADATION, METABOLISM, MICROORGANISMS, FUNGI, BIBLIOGRAPHIES,
[illegible] HYDROCARBONS, BIODEGRADATION, [illegible], BACTERIA, REFINERIES,
[illegible] HYDROCARBONS, BIODEGRADATION, [illegible], BACTERIA, SEDIMENTS, SEAWATER,
[illegible] HYDROCARBONS, BIODEGRADATION, [illegible], ANALYTICAL TECHNIQUES, SPECTROMETRY,

0393 HYDROCARBONS, SEDIMENTATION, OIL SLICKS, EVAPORATION, ADSORPTION, *SUBTIDAL ENVIRONMENTS,
0392 HYDROCARBONS, FATE, OIL SLICKS, WEATHERING, SEDIMENTATION,
0397 HYDROCARBONS, OIL SPILLS, FATE, DISTRIBUTION, *SALT MARSH, BIOLOGICAL EFFECTS,
0398 HYDROCARBONS, FATE, METABOLISM, FOOD WEB, MARINE ORGANISMS, MICROORGANISMS,
0601 HYDROCARBONS, MOVEMENT, FATE, BIODEGRADATION, MARINE ORGANISMS, *CHEMORECEPTION,
0609 HYDROCARBONS, FATE, METABOLISM, PHYTOPLANKTON, ZOOPLANKTON, FISHES, INVERTEBRATES,
0606 HYDROCARBONS, OIL SPILLS, FATE, DISPERSION, GROUNDWATER,
0607 HYDROCARBONS, GROUNDWATER, WATER QUALITY, DISPERSIONS,
0610 HYDROCARBONS, DECOMPOSITION, JAPAN, *HEXADECANE, *SHIMODA BAY,
0611 HYDROCARBONS, DECOMPOSITION, *HEXADECANE, SEAWATER, JAPAN,
0613 HYDROCARBONS, PAH, OCEANS, SOURCE IDENTIFICATION, PLANTS, OIL SPILLS, FATE,
0616 HYDROCARBONS, ADSORPTION, OFFSHORE DRILLING, OIL TRANSPORT, *PARTICULATE MATTER,
0108 INCINERATION, CLEANUP, OIL SPILLS, DISPOSAL, CANADA,
0149 INCINERATION, WASTEWATER TREATMENT, REFINERIES, SLUDGE, YUGOSLAVIA,
0161 INCINERATION, WASTE OIL TREATMENT, FUEL OIL, *SOLID WASTES, *SEWAGE, DISPOSAL,
0163 INCINERATION, WASTEWATER TREATMENT, PETROCHEMICALS, OIL INDUSTRY, OIL-WATER SEPARATION, OXIDATION, FLOTATION, FILTRATION, ADSORPTION,
0193 INCINERATION, WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION, FILTRATION, FUEL OIL,
0219 INDIA, CRANKCASE OIL, RECLAMATION, REFINING,
0223 INDIA, REFINING, RECYCLING, CRANKCASE OIL, WASTE OIL,
0225 INDIA, RECYCLING, REUSE, CRANKCASE OIL, LUBRICATING OIL,
0395 INDIA, CRUDE OIL, FATE, CHEMICAL ANALYSIS, CHROMATOGRAPHY, BEACHES, COASTS, *TAR BALLS,
0509 INDONESIA, OIL SPILLS, COASTS, ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING,
0152 INDUSTRIES, POLLUTION PREVENTION, WASTEWATER TREATMENT, PETROCHEMICALS, SOCIO-ECONOMIC EFFECTS, ECONOMICS, LEGISLATION,
0169 INDUSTRIES, WASTEWATER TREATMENT, CONTAMINANTS, FLOCCULATION, *POLYELECTROLYTES,
0207 INDUSTRIES, WATER QUALITY, WASTEWATER TREATMENT, REGULATIONS, *SOIL POLLUTION, *SEWAGE,
0226 INDUSTRIES, RECYCLING, SOLID WASTES, WASTEWATERS, WASTE OIL, PETROCHEMICALS, MANUALS,
0264 INDUSTRIES, POLLUTION PREVENTION, OIL SPILLS, GOVERNMENT AGENCIES, CANADA, LEGISLATION, PERSONNEL TRAINING,
0639 INDUSTRIES, BIBLIOGRAPHIES, WASTEWATER TREATMENT, PETROCHEMICALS, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0668 INDUSTRIES, BIBLIOGRAPHIES, WASTEWATER TREATMENT, PETROCHEMICALS, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0011 INFORMATION SYSTEMS, OIL SPILLS, POLLUTION PREVENTION, *SPILLS NEWSLETTER,
0013 INFORMATION SYSTEMS, OIL SPILLS, CLEANUP, ENVIRONMENTAL PROTECTION, CONTINGENCY PLANNING, ECONOMICS, *DATA BASE, *U.S. NAVY,
0015 INFORMATION SYSTEMS, OIL SPILLS, CANADA,
0008 INLAND, OIL SPILLS, CRUDE OIL, FUEL OIL, U.S., CANADA,
0018 INLAND, OIL SPILLS, POLLUTION PREVENTION, LEGISLATION, LIABILITY, CONTINGENCY PLANNING, *REPORTING REQUIREMENTS,
0132 INSURANCE, TANKERS, DESIGN-ENGINEERING, OIL SPILLS, INTERNATIONAL CONVENTIONS, LEGISLATION, LIABILITY,
0625 INSURANCE, INTERNATIONAL CONVENTIONS, OIL SPILLS, LIABILITY, TANKERS, SHIPS,
0636 INSURANCE, OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, LEGISLATION, ECONOMICS,
0550 INSURANCE, BIBLIOGRAPHIES, OFFSHORE DRILLING, LIABILITY, *OIL RIG INSURANCE,
0626 INTERNATIONAL AGREEMENTS, LEGISLATION, EUROPE, POLLUTION PREVENTION, OCEANS, OFFSHORE PRODUCTION, OIL DISCHARGES, CLEANUP,
0631 INTERNATIONAL AGREEMENTS, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, SHIPS, LEGISLATION, LIABILITY, ECONOMICS,
0133 INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS, DESIGN-ENGINEERING, OIL SPILLS, LEGISLATION, LIABILITY,
0136 INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, OCEANS, OIL SPILLS, OIL DISCHARGES, WASTEWATERS, *IMCO,
0248 INTERNATIONAL CONVENTIONS, HYDROCARBONS, POLLUTION PREVENTION,
0252 INTERNATIONAL CONVENTIONS, POLLUTION CONTROL, ENVIRONMENTAL PROTECTION, OIL DISCHARGES, MEDITERRANEAN SEA,
0382 INTERNATIONAL CONVENTIONS, OIL SPILLS, TANKERS, ENVIRONMENTAL EFFECTS, POLLUTION CONTROL, CLEANUP, CONTINGENCY PLANNING,
0627 INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, OIL SPILLS, OIL DISCHARGES,
0628 INTERNATIONAL CONVENTIONS, INSURANCE, OIL SPILLS, LIABILITY, TANKERS, SHIPS,
0629 INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, OIL DISCHARGES, MEDITERRANEAN SEA,
0630 INTERNATIONAL CONVENTIONS, OIL SPILLS, CONTAMINATION, ENVIRONMENTAL EFFECTS, OCEANS, *OCEANS,
0631 INTERNATIONAL CONVENTIONS, INTERNATIONAL AGREEMENTS, POLLUTION PREVENTION, SHIPS, LEGISLATION, LIABILITY, ECONOMICS,
0632 INTERNATIONAL CONVENTIONS, LIABILITY, OIL SPILLS, LEGISLATION, *U.S. LAW OF THE SEA,
0633 INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, ENVIRONMENTAL PROTECTION, BALTIC SEA, OIL DISCHARGES, SHIPS,
0636 INTERNATIONAL CONVENTIONS, INSURANCE, OIL SPILLS, LIABILITY, LEGISLATION, ECONOMICS,
0296 INTERTIDAL ZONE, OIL SPILLS, FUEL OIL, EMULSIFIERS, BIOLOGICAL EFFECTS, MARINE ORGANISMS, MASSACHUSETTS, *WEST FALMOUTH SPILL,
0285 INVERTEBRATES, HYDROCARBONS, BIOLOGICAL EFFECTS, FISHES, ALGAE, *PHYSIOLOGICAL

EFFECTS, *BIOCHEMICAL EFFECTS,
0280 INVERTEBRATES, TOXICITY, CRUDE OIL, MARINE ORGANISMS, ARCTIC, METABOLISM,
0409 INVERTEBRATES, HYDROCARBONS, FATE, METABOLISM, PHYTOPLANKTON, ZOOPLANKTON, FISHES,
0097 IRELAND, RECOVERY, OIL SPILLS, SKIMMERS, DESIGN&ENGINEERING, BANTRY BAY,
0023 JAPAN, OIL SPILLS, CONTAMINATION, BIOLOGICAL EFFECTS, LEGISLATION, POLLUTION PREVENTION,
0138 JAPAN, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTERS, TANKERS,
0220 JAPAN, WASTE OIL TREATMENT, RECLAMATION, REFINING,
0221 JAPAN, WASTE OIL TREATMENT, RECLAMATION, REFINING, LUBRICATING OIL, SOLVENTS,
0310 JAPAN, OIL SPILLS, CRUDE OIL, TANKERS, BEACHES, *NIIGATA COAST,
0410 JAPAN, HYDROCARBONS, DECOMPOSITION, *HEXADECANE, *[illegible] BAY,
0411 JAPAN, HYDROCARBONS, DECOMPOSITION, *HEXADECANE, SEAWATER,
0051 JAPAN/SEA OF, REMOTE SENSING, OIL SPILLS, OIL SLICKS, SPREADING,
0288 LAKES, BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, VENEZUELA, *LAKE MARACAIBO,
0289 LAKES, OIL DISCHARGES, WASTEWATERS, BIOLOGICAL EFFECTS, FATE, FISHERIES, VENEZUELA, ECONOMICS, *LAKE MARACAIBO,
0297 LAKES, BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, VENEZUELA, *LAKE MARACAIBO,
0298 LAKES, OIL DISCHARGES, WASTEWATERS, BIOLOGICAL EFFECTS, FISHERIES, VENEZUELA, ECONOMICS, *LAKE MARACAIBO,
0323 LAKES, CHEMICAL ANALYSIS, SAMPLING, [illegible] SEDIMENTS, DISTRIBUTION, *DREDGED SPOILS,
0232 LAW ENFORCEMENT, POLLUTION PREVENTION, REGULATIONS, *CIVIL PENALTIES, *U.S. EPA,
0420 LAW ENFORCEMENT, LEGISLATION, U.S., OIL DISCHARGES, *MEXICO,
0125 LEAKAGE, STORAGE, CRUDE OIL, PETROLEUM PRODUCTS, SAFETY, ECONOMICS, *UNDERGROUND SALT CAVERNS,
0018 LEGISLATION, IRELAND, OIL SPILLS, POLLUTION PREVENTION, LIABILITY, CONTINGENCY PLANNING, *REPORTING REQUIREMENTS,
0023 LEGISLATION, JAPAN, OIL SPILLS, CONTAMINATION, BIOLOGICAL EFFECTS, POLLUTION PREVENTION,
0133 LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS, DESIGN&ENGINEERING, OIL SPILLS, LIABILITY,
0152 LEGISLATION, INDUSTRIES, POLLUTION PREVENTION, WASTEWATER TREATMENT, PETROCHEMICALS, SOCIO-ECONOMIC EFFECTS, ECONOMICS,
0216 LEGISLATION, GUIDELINES, WASTE OIL, DISPOSAL, RECYCLING, [illegible],
0219 LEGISLATION, WASTE OIL TREATMENT, RECYCLING, FUEL OIL, LUBRICATING OIL, U.K.,
0237 LEGISLATION, POLLUTION PREVENTION, OIL SPILLS, STORAGE, DISCHARGES, CONTINGENCY PLANNING, *[illegible],
0284 LEGISLATION, INDUSTRIES, POLLUTION PREVENTION, OIL SPILLS, GOVERNMENT AGENCIES, CANADA, PERSONNEL TRAINING,
0285 LEGISLATION, OIL SPILLS, POLLUTION PREVENTION, POLLUTION CONTROL, U.S., CANADA, CONTINGENCY PLANNING, OIL DISCHARGES,
0366 LEGISLATION, U.S., OFFSHORE DEVELOPMENT, OCS, DELAWARE, LIABILITY, OIL SPILLS, ENVIRONMENTAL PROTECTION,
0417 LEGISLATION, STATE GOVERNMENTS, ENVIRONMENTAL PROTECTION, OFFSHORE DEVELOPMENT, PORTS, NORTH CAROLINA,
0418 LEGISLATION, OFFSHORE DEVELOPMENT, U.S. GOVERNMENT, STATE GOVERNMENTS, NORTH CAROLINA,
0419 LEGISLATION, LIABILITY, U.S., OIL SPILLS, *COMPENSATION,
0420 LEGISLATION, LAW ENFORCEMENT, U.S., OIL DISCHARGES, *MEXICO,
0421 LEGISLATION, OIL SPILLS, LIABILITY, *PRIVATE DAMAGE SUITS, U.S.,
0422 LEGISLATION, U.S., STORAGE, CRUDE OIL, OIL TANKS, FIRES, ENVIRONMENTAL EFFECTS,
0425 LEGISLATION, ENVIRONMENTAL PROTECTION, POLLUTION PREVENTION, LIABILITY,
0426 LEGISLATION, INTERNATIONAL AGREEMENTS, EUROPE, POLLUTION PREVENTION, OCEANS, OFFSHORE PRODUCTION, OIL DISCHARGES, CLEANUP,
0431 LEGISLATION, INTERNATIONAL CONVENTIONS, INTERNATIONAL AGREEMENTS, POLLUTION PREVENTION, SHIPS, LIABILITY, ECONOMICS,
0432 LEGISLATION, INTERNATIONAL CONVENTIONS, LIABILITY, OIL SPILLS, *U.N. LAW OF THE SEA,
0436 LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, OIL SPILLS, LIABILITY, ECONOMICS,
0018 LIABILITY, LEGISLATION, IRELAND, OIL SPILLS, POLLUTION PREVENTION, CONTINGENCY PLANNING, *REPORTING REQUIREMENTS,
0133 LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS, DESIGN&ENGINEERING, OIL SPILLS,
0350 LIABILITY, REGULATIONS, OIL SPILLS, TANKERS, SAFETY, POLLUTION PREVENTION,
0366 LIABILITY, LEGISLATION, U.S., OFFSHORE DEVELOPMENT, OCS, DELAWARE, OIL SPILLS, ENVIRONMENTAL PROTECTION,
0419 LIABILITY, LEGISLATION, U.S., OIL SPILLS, *COMPENSATION,
0421 LIABILITY, LEGISLATION, OIL SPILLS, *PRIVATE DAMAGE SUITS, U.S.,
0425 LIABILITY, LEGISLATION, ENVIRONMENTAL PROTECTION, POLLUTION PREVENTION,
0428 LIABILITY, INTERNATIONAL CONVENTIONS, INSURANCE, OIL SPILLS, TANKERS, SHIPS,
0431 LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INTERNATIONAL AGREEMENTS, POLLUTION PREVENTION, SHIPS, ECONOMICS,
0432 LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, OIL SPILLS, *U.N. LAW OF THE SEA,
0436 LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, OIL SPILLS, ECONOMICS,
0460 LIABILITY, INSURANCE, BIBLIOGRAPHIES, OFFSHORE DRILLING, *OIL RIG INSURANCE,
0097 LOUISIANA, OIL SPILLS, COASTS, ENVIRONMENTAL PROTECTION, PORTS,
0113 LOUISIANA, HYDROCARBONS, CHEMICAL EFFECTS, SEDIMENTS, OIL FIELDS, MICROORGANISMS, *PETROLEUM DEGRADATION,
0329 LOUISIANA, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, FISHERIES, CRUDE OIL, TOXICITY

[illegible] LUBRICATING OIL, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, *LUMINESCENCE, CRUDE OIL,
[illegible] LUBRICATING OIL, WASTE OIL TREATMENT, DISPOSAL, ENVIRONMENTAL EFFECTS, RECLAMATION,
[illegible] LUBRICATING OIL, WASTEWATER TREATMENT, BILGES, EMULSIONS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, FUEL OIL,
[illegible] LUBRICATING OIL, WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION, FLOCCULATION, FILTRATION,
[illegible] LUBRICATING OIL, RECLAMATION, WASTE OIL, FUEL OIL, CRANKCASE OIL,
[illegible] LUBRICATING OIL, LEGISLATION, WASTE OIL TREATMENT, RECYCLING, FUEL OIL, U.S.,
[illegible] LUBRICATING OIL, RECLAMATION, CRANKCASE OIL, RECYCLING,
[illegible] LUBRICATING OIL, WASTE OIL, RECLAMATION, REFINING,
[illegible] LUBRICATING OIL, SPAN, WASTE OIL TREATMENT, RECLAMATION, REFINING, SOLVENTS,
[illegible] LUBRICATING OIL, RECLAMATION, REUSE, WASTE OIL, FUELS,
[illegible] LUBRICATING OIL, TESTS, RECYCLING, REUSE, CRANKCASE OIL,
[illegible] MAGELLAN/STRAIT OF, OIL SPILLS, BEACHES, METULA OIL SPILL, TANKERS,
[illegible] MANUALS, INDUSTRIES, RECYCLING, SOLID WASTES, WASTEWATERS, WASTE OIL, PETROCHEMICALS,
[illegible] MANUALS, GUIDELINES, OIL SPILLS, POLLUTION PREVENTION, CONTAINMENT, CLEANUP,
[illegible] MARINE MAMMALS, CONTAMINATION, CRUDE OIL, *RINGED SEALS, BIOLOGICAL EFFECTS, OFFSHORE PIPELINES,
[illegible] MARINE ORGANISMS, OIL SPILLS, FUEL OIL, CHESAPEAKE BAY, BEACHES, BIRDS, *OIL BARGE,
[illegible] MARINE ORGANISMS, OIL SPILLS, TANKERS, CLEANUP, DISPERSANTS, TOXIC EFFECTS, SPAIN, *URQUIOLA OIL SPILL,
[illegible] MARINE ORGANISMS, MONITORING, SAMPLING, OIL SLICKS, TAR, ANALYTICAL TECHNIQUES, SEDIMENTS, SEAWATER,
[illegible] MARINE ORGANISMS, CHEMICAL ANALYSIS, PAH, *BENZO(A)PYRENE, CHROMATOGRAPHY, *FLUORIMETRY, MONITORING, SEDIMENTS,
[illegible] MARINE ORGANISMS, PAH, CHEMICAL ANALYSIS, CHROMATOGRAPHY, *SHELLFISH,
[illegible] MARINE ORGANISMS, OIL TRANSPORT, OIL SPILLS, ENVIRONMENTAL DETERIORATION, CHRONIC EFFECTS,
[illegible] MARINE ORGANISMS, HYDROCARBONS, BIOLOGICAL EFFECTS,
[illegible] MARINE ORGANISMS, HYDROCARBONS, MOLLUSKS, *UPTAKE AND DEPURATION,
[illegible] MARINE ORGANISMS, HYDROCARBONS, FATE, FUEL OIL, FISHES, MOLLUSKS, CRUSTACEANS, *ACCUMULATION AND RELEASE STUDIES,
[illegible] MARINE ORGANISMS, ACUTE EFFECTS, CHRONIC EFFECTS, OIL SPILLS, PETROLEUM PRODUCTS, DISPERSANTS, MONITORING,
[illegible] MARINE ORGANISMS, OIL SPILLS, BIOLOGICAL EFFECTS, MASSACHUSETTS, *WEST FALMOUTH SPILL,
[illegible] MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS, PETROCHEMICALS, PUGET SOUND, *LITERATURE REVIEW,
[illegible] MARINE ORGANISMS, TAR, BIOLOGICAL EFFECTS, ECHINODERMS, *EGG DEVELOPMENT,
[illegible] MARINE ORGANISMS, OIL SPILLS, DISPERSANTS, TOXICITY, ACUTE EFFECTS, CHRONIC EFFECTS,
[illegible] MARINE ORGANISMS, METABOLISM, CONTAMINANTS, TOXICITY,
[illegible] MARINE ORGANISMS, MODELS, BIOLOGICAL EFFECTS, OIL SPILLS,
[illegible] MARINE ORGANISMS, OIL SPILLS, DISPERSANTS, BIOLOGICAL EFFECTS, MOLLUSKS, FRANCE, *BRITTANY COAST,
[illegible] MARINE ORGANISMS, INVERTEBRATES, TOXICITY, CRUDE OIL, ARCTIC, METABOLISM,
[illegible] MARINE ORGANISMS, BIOLOGICAL EFFECTS, CRUDE OIL, CRUSTACEANS, *OXYGEN CONSUMPTION,
[illegible] MARINE ORGANISMS, INTERTIDAL ZONE, OIL SPILLS, FUEL OIL, EMULSIFIERS, BIOLOGICAL EFFECTS, MASSACHUSETTS, *WEST FALMOUTH SPILL,
[illegible] MARINE ORGANISMS, CONTAMINATION, *MARINE ECOLOGY,
[illegible] MARINE ORGANISMS, GUIDELINES, ENVIRONMENTAL PROTECTION, CONTAMINATION,
[illegible] MARINE ORGANISMS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, ANALYTICAL TECHNIQUES, CRUDE OIL, FATE, OCEANS,
[illegible] MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, FUEL OIL, OIL SPILLS, SHORELINES, RECOLONIZATION, CANADA, CHEDABUCTO BAY,
[illegible] MARINE ORGANISMS, OFFSHORE DRILLING, BIOLOGICAL EFFECTS, OIL SPILLS, *DRILLING MUD COMPONENTS,
[illegible] MARINE ORGANISMS, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, MEXICO/GULF OF, VENEZUELA, NATURAL SEEPAGE, SANTA BARBARA CHANNEL, TAR, BERMUDA COAST,
[illegible] MARINE ORGANISMS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING,
[illegible] MARINE ORGANISMS, HYDROCARBONS, SEDIMENTS, COASTS, PRUDHOE BAY, ALASKA,
[illegible] MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING,
[illegible] MARINE ORGANISMS, OIL SPILLS, BEHAVIOR, *FREEZING CONDITIONS, EVAPORATION, BIOLOGICAL EFFECTS,
[illegible] MARINE ORGANISMS, HYDROCARBONS, FATE, METABOLISM, FOOD WEB, MICROORGANISMS,
[illegible] MARINE ORGANISMS, HYDROCARBONS, MOVEMENT, FATE, BIODEGRADATION, *CHEMORECEPTION,
[illegible] MARINE ORGANISMS, FATE, FUEL OIL, CHEDABUCTO BAY, CANADA, BEACHES, SEDIMENTS, *WATER COLUMN, CHRONIC EFFECTS,
[illegible] MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, OIL SPILLS, PETROCHEMICALS, PUGET SOUND,
[illegible] MARINE ORGANISMS, BIBLIOGRAPHIES, OIL SPILLS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, TOXICITY,
[illegible] MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, BIODEGRADATION, *TROPICAL WATERS,
[illegible] MARYLAND, HARBORS, REMOTE SENSING, RIVERS, WASTEWATERS, OIL DISCHARGES, WATER QUALITY,
[illegible] MASSACHUSETTS, MARINE ORGANISMS, OIL SPILLS, BIOLOGICAL EFFECTS, *WEST FALMOUTH SPILL,

0294 MASSACHUSETTS, MARINE ORGANISMS, INTERTIDAL ZONE, OIL SPILLS, FUEL OIL, EMULSIFIERS, BIOLOGICAL EFFECTS, *WEST FALMOUTH SPILL,
0012 MEDITERRANEAN SEA, HYDROCARBONS, CONTAMINATION, OIL DISCHARGES, TANKERS, REFINERIES,
0342 MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, POLLUTION CONTROL, ENVIRONMENTAL PROTECTION, OIL DISCHARGES,
0425 MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, OIL DISCHARGES,
0274 METABOLISM, HYDROCARBONS, BIOLOGICAL EFFECTS, ZOOPLANKTON, TOXICITY,
0275 METABOLISM, TOXICITY, ACUTE EFFECTS, CHRONIC EFFECTS, CRUDE OIL, FUEL OIL, CRUSTACEANS, *MUD CRAB,
0279 METABOLISM, BIOLOGICAL EFFECTS, OIL SPILLS, FUEL OIL, MOLLUSKS, *MYA ARENARIA, *CARBON FLUX,
0281 METABOLISM, MARINE ORGANISMS, CONTAMINANTS, TOXICITY,
0284 METABOLISM, HYDROCARBONS, FATE, CRUSTACEANS, *BLUE CRAB,
0290 METABOLISM, MARINE ORGANISMS, INVERTEBRATES, TOXICITY, CRUDE OIL, ARCTIC,
0300 METABOLISM, HYDROCARBONS, MONITORING, FATE, MOLLUSKS, *OYSTERS, *CRASSOSTREA VIRGINICA,
0305 METABOLISM, HYDROCARBONS, BIOLOGICAL EFFECTS, FISHES, TOXICITY,
0306 METABOLISM, BIOLOGICAL EFFECTS, CRUDE OIL, POLYCHAETES, *NEANTHES ARENACEODENTATA,
0376 METABOLISM, HYDROCARBONS, BIODEGRADATION, FUNGI, YEASTS,
0380 METABOLISM, HYDROCARBONS, BIODEGRADATION, BACTERIA, *PHOSPHORUS REQUIREMENTS,
0384 METABOLISM, BIODEGRADATION, BACTERIA, SOIL, FUEL OIL, CRANKCASE OIL, CRUDE OIL,
0385 METABOLISM, HYDROCARBONS, BIODEGRADATION, MICROORGANISMS, FUNGI, BIBLIOGRAPHIES,
0388 METABOLISM, HARBORS, BIODEGRADATION, CONTAMINANTS, BACTERIA, CHESAPEAKE BAY, *MERCURY INHIBITION,
0396 METABOLISM, MARINE ORGANISMS, HYDROCARBONS, FATE, FOOD WEB, MICROORGANISMS,
0404 METABOLISM, INVERTEBRATES, HYDROCARBONS, FATE, PHYTOPLANKTON, ZOOPLANKTON, FISHES,
0001 METULA OIL SPILL, MAGELLAN/STRAIT OF, OIL SPILLS, BEACHES, TANKERS,
0035 MEXICO/GULF OF, HYDROCARBONS, MONITORING, BEACHES, CHEMICAL ANALYSIS,
0326 MEXICO/GULF OF, MARINE ORGANISMS, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, VENEZUELA, NATURAL SEEPAGE, SANTA BARBARA CHANNEL, TAR, BERMUDA COAST,
0336 MEXICO/GULF OF, GUIDELINES, ECONOMIC EFFECTS, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, ALASKA, CALIFORNIA,
0062 MICROORGANISMS, HYDROCARBONS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, ESTUARIES, NORTH CAROLINA,
0333 MICROORGANISMS, LOUISIANA, HYDROCARBONS, CHEMICAL EFFECTS, SEDIMENTS, OIL FIELDS, *PETROLEUM DISSOLUTION,
0375 MICROORGANISMS, BIODEGRADATION, OIL SPILLS, CLEANUP, *NUTRIENT ADDITION,
0377 MICROORGANISMS, BIODEGRADATION, CRUDE OIL, BACTERIA, CLEANUP, MONITORING, OIL SPILLS,
0378 MICROORGANISMS, BIODEGRADATION, CRUDE OIL, OXIDATION, BEACHES, MONITORING,
0379 MICROORGANISMS, BIODEGRADATION, DECOMPOSITION, CRUDE OIL, *MINERAL OIL,
0381 MICROORGANISMS, BIODEGRADATION, AROMATIC HYDROCARBONS, TAR, SOIL, *WATERS,
0383 MICROORGANISMS, HYDROCARBONS, BIODEGRADATION, OIL SPILLS, *CELLULOSIC SUBSTRATES,
0385 MICROORGANISMS, METABOLISM, HYDROCARBONS, BIODEGRADATION, FUNGI, BIBLIOGRAPHIES,
0396 MICROORGANISMS, METABOLISM, MARINE ORGANISMS, HYDROCARBONS, FATE, FOOD WEB,
0087 MODELS, REMOTE SENSING, OIL SLICKS, MOVEMENT, DELAWARE BAY,
0089 MODELS, REMOTE SENSING, ESTUARIES, DELAWARE BAY, DRIFT, SPREADING, OIL SLICKS, *FRONTS,
0286 MODELS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS,
0335 MODELS, ECONOMICS, REFINERIES, OIL SPILLS, BIODEGRADATION, CALIFORNIA, *CRUDE OIL COSTS,
0395 MODELS, FATE, DRIFT, OIL SPILLS, *DISCRETE-PARCEL-RANDOM-WALK MODEL,
0405 MODELS, OIL DISCHARGES, FATE, ESTUARIES,
0412 MODELS, OIL SLICKS, MOVEMENT, ST. LAWRENCE RIVER, CANADA,
0030 MOLLUSKS, HYDROCARBONS, MONITORING, DETECTION, BALTIC SEA, *BLUE MUSSEL, *KIEL BIGHT,
0060 MOLLUSKS, HYDROCARBONS, SAMPLING, CHEMICAL ANALYSIS, CHROMATOGRAPHY, ADRIATIC SEA, *MUSSELS, *GULF OF VENICE,
0255 MOLLUSKS, MARINE ORGANISMS, HYDROCARBONS, *UPTAKE AND DEPURATION,
0256 MOLLUSKS, MARINE ORGANISMS, HYDROCARBONS, FATE, FUEL OIL, FISHES, CRUSTACEANS, *ACCUMULATION AND RELEASE STUDIES,
0261 MOLLUSKS, BIOLOGICAL EFFECTS, DISPERSANTS, CRUDE OIL, TOXICITY, *RESPIRATION RATE,
0267 MOLLUSKS, HYDROCARBONS, TOXICITY, SEDIMENTS, NORTH SEA, *OYSTERS,
0279 MOLLUSKS, METABOLISM, BIOLOGICAL EFFECTS, OIL SPILLS, FUEL OIL, *MYA ARENARIA, *CARBON FLUX,
0287 MOLLUSKS, HYDROCARBONS, BIOLOGICAL EFFECTS, CRUSTACEANS, *SHELLFISH, *OIL POLLUTION,
0289 MOLLUSKS, MARINE ORGANISMS, OIL SPILLS, DISPERSANTS, BIOLOGICAL EFFECTS, FRANCE, *NORMAN COAST,
0300 MOLLUSKS, METABOLISM, HYDROCARBONS, MONITORING, FATE, *OYSTERS, *CRASSOSTREA VIRGINICA,
0024 MONITORING, HYDROCARBONS, BILGES, BALLAST, DESIGN-ENGINEERING, *FLUORESCENCE, *OIL-IN-WATER,
0025 MONITORING, REFINERIES, PETROCHEMICALS, VENEZUELA, ENVIRONMENTAL EFFECTS, *BASELINE STUDIES,
0026 MONITORING, TAR, OCEANS, DETECTION, DISTRIBUTION,
0027 MONITORING, HYDROCARBONS, SAMPLING, STORAGE,
0028 MONITORING, MARINE ORGANISMS, SAMPLING, OIL SLICKS, TAR, ANALYTICAL TECHNIQUES, SEDIMENTS, SEAWATER,
0029 MONITORING, HYDROCARBONS, BEACHES, NEW JERSEY,
0030 MONITORING, MOLLUSKS, HYDROCARBONS, DETECTION, BALTIC SEA, *BLUE MUSSEL, *KIEL BIGHT,

[illegible] MONITORING, *OIL POLLUTION, DESIGN-ENGINEERING.
[illegible] MONITORING, ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, OIL SPILLS, *LUMINESCENCE METHODS.
[illegible] MONITORING, DETECTION, *OIL-IN-WATER, SHIPS, DESIGN-ENGINEERING.
[illegible] MONITORING, DETECTION, *OIL-IN-WATER, SHIPS, *FLAME SPECTROSCOPY.
[illegible] MONITORING, MEXICO, GULF OF, HYDROCARBONS, BEACHES, CHEMICAL ANALYSIS.
[illegible] MONITORING, REMOTE SENSING, CONTAMINANTS, PETROLEUM PRODUCTS, WATER QUALITY, *AIR QUALITY.
0037 MONITORING, REFINERIES, WASHINGTON, *PHYSICAL AND CHEMICAL CHARACTERIZATION, OCEANS, *CHERRY POINT REFINERY.
0038 MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, CHERRY POINT REFINERY.
0039 MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, *CHERRY POINT REFINERY.
0040 MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, OIL DISCHARGES, REFINERIES, OIL SPILLS, WASHINGTON, *CHERRY POINT REFINERY.
[illegible] MONITORING, CONTAMINATION, BIRDS, OIL SPILLS, COASTS, CANADA.
[illegible] MONITORING, TAR, OCEANS, PACIFIC OCEAN, DISTRIBUTION.
[illegible] MONITORING, HYDROCARBONS, BALTIC SEA, CRUSTACEANS, FISHES, BIODEGRADATION, BACTERIA.
[illegible] MONITORING, ANALYTICAL TECHNIQUES, OIL-WATER SEPARATION, DESIGN-ENGINEERING.
[illegible] MONITORING, HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, FISHES, *SUBANTARCTIC PELAGIC BIRDS, *STOMACH OIL.
[illegible] MONITORING, MARINE ORGANISMS, CHEMICAL ANALYSIS, PAH, *BENZO(A)PYRENE, CHROMATOGRAPHY, *FLUORIMETRY, SEDIMENTS.
[illegible] MONITORING, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, REMOTE SENSING.
[illegible] MONITORING, OIL SPILLS, POLLUTION PREVENTION, CONTINGENCY PLANNING, BOOMS, SKIMMERS.
[illegible] MONITORING, MARINE ORGANISMS, ACUTE EFFECTS, CHRONIC EFFECTS, OIL SPILLS, PETROLEUM PRODUCTS, REFINERIES.
[illegible] MONITORING, MOLLUSKS, METABOLISM, HYDROCARBONS, FATE, *OYSTERS, *CRASSOSTREA VIRGINICA.
[illegible] MONITORING, BIOLOGICAL EFFECTS, CRUDE OIL, CRUSTACEANS, TOXICITY, *AMERICAN LOBSTER.
[illegible] MONITORING, OFFSHORE PRODUCTION, NORTH SEA, OIL SPILLS, BIOLOGICAL EFFECTS, SEABIRDS, POLLUTION CONTROL.
[illegible] MONITORING, MICROORGANISMS, BIODEGRADATION, CRUDE OIL, BACTERIA, CLEANUP, OIL SPILLS.
[illegible] MONITORING, MICROORGANISMS, BIODEGRADATION, CRUDE OIL, OXIDATION, BEACHES.
[illegible] MOVEMENT, MODELS, REMOTE SENSING, OIL SLICKS, DELAWARE BAY.
[illegible] MOVEMENT, DRILLING, OIL SPILLS, BEAUFORT SEA, CANADA, *OIL-UNDER-ICE.
[illegible] MOVEMENT, MARINE ORGANISMS, HYDROCARBONS, FATE, BIODEGRADATION, *CHEMORECEPTION.
[illegible] MOVEMENT, MODELS, OIL SLICKS, ST. LAWRENCE RIVER, CANADA.
[illegible] NATURAL SEEPAGE, REMOTE SENSING, DETECTION, OIL SPILLS, *FRAUNHOFER LINE DISCRIMINATOR.
[illegible] NATURAL SEEPAGE, MEXICO, GULF OF, MARINE ORGANISMS, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, VENEZUELA, SANTA BARBARA CHANNEL, TAR, BERMUDA COAST.
[illegible] NATURAL SEEPAGE, SOUTHERN CALIFORNIA, *COAL OIL POINT, *GEOLOGIC HISTORY.
[illegible] NEW JERSEY, MONITORING, HYDROCARBONS, BEACHES.
[illegible] NEW YORK, CONTAMINATION, WASTE OIL, *SEWAGE, BEACHES.
[illegible] NORTH CAROLINA, MICROORGANISMS, HYDROCARBONS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, ESTUARIES.
[illegible] NORTH CAROLINA, LEGISLATION, STATE GOVERNMENTS, ENVIRONMENTAL PROTECTION, OFFSHORE DEVELOPMENT, PORTS.
[illegible] NORTH CAROLINA, LEGISLATION, OFFSHORE DEVELOPMENT, U.S. GOVERNMENT, STATE GOVERNMENTS.
[illegible] NORTH SEA, MOLLUSKS, HYDROCARBONS, TOXICITY, SEDIMENTS, *OYSTERS.
[illegible] NORTH SEA, BIOLOGICAL EFFECTS, OIL SPILLS, BEHAVIOR, FATE, CLEANUP.
[illegible] NORTH SEA, MONITORING, OFFSHORE PRODUCTION, OIL SPILLS, BIOLOGICAL EFFECTS, SEABIRDS, POLLUTION CONTROL.
[illegible] NORWEGIAN SEA, CLEANUP, RECOVERY, OIL SPILLS, SKIMMERS, OIL-WATER SEPARATION.
[illegible] OCEANS, OIL TRANSPORT, CRUDE OIL, PETROLEUM PRODUCTS, OIL DISCHARGES, CARCINOGENS.
[illegible] OCEANS, MONITORING, TAR, DETECTION, DISTRIBUTION.
0037 OCEANS, MONITORING, REFINERIES, WASHINGTON, *PHYSICAL AND CHEMICAL CHARACTERIZATION, *CHERRY POINT REFINERY.
[illegible] OCEANS, MONITORING, TAR, PACIFIC OCEAN, DISTRIBUTION.
[illegible] OCEANS, REMOTE SENSING, OIL SLICKS, EMULSIONS, *THERMAL RADIATION, *FLUID FILMS.
0136 OCEANS, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, OIL SPILLS, OIL DISCHARGES, WASTEWATERS, *IMCO.
[illegible] OCEANS, GOVERNMENT AGENCIES, GERMANY, WEST, POLLUTION PREVENTION, OIL SPILLS, COASTS.
[illegible] OCEANS, OIL SPILLS, POLLUTION PREVENTION, CLEANUP, REGULATIONS, UK.
[illegible] OCEANS, CONTAMINATION, ENGLAND, *ADVISORY COMMITTEE ON OIL POLLUTION.
[illegible] OCEANS, HYDROCARBONS, CONTAMINATION, *MARINE POLLUTANTS, ENVIRONMENTAL EFFECTS.
[illegible] OCEANS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, ANALYTICAL TECHNIQUES, CRUDE OIL, FATE.
[illegible] OCEANS, HYDROCARBONS, BIODEGRADATION, BACTERIA, REFINERIES.
[illegible] OCEANS, FATE, CRUDE OIL, EVAPORATION, WEATHERING, BIODEGRADATION.
[illegible] OCEANS, HYDROCARBONS, PAH, SOURCE IDENTIFICATION, PLANTS, OIL SPILLS, FATE.
[illegible] OCEANS, FATE, OIL SPILLS, BIBLIOGRAPHIES, *PHYSICAL CHANGES, *CHEMICAL CHANGES.
[illegible] OCEANS, LEGISLATION, INTERNATIONAL AGREEMENTS, EUROPE, POLLUTION PREVENTION, OFFSHORE PRODUCTION, OIL DISCHARGES, CLEANUP.
[illegible] OCEANS, INTERNATIONAL CONVENTIONS, OIL SPILLS, CONTAMINATION, ENVIRONMENTAL EFFECTS,

[illegible]
0002 OCS, OFFSHORE DRILLING, ATLANTIC COAST, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
0230 OCS, CONTINGENCY PLANNING, OIL SPILLS, OFFSHORE DRILLING, OIL TRANSPORT, ATLANTIC COAST, *RESEARCH NEEDS, *U.S. EPA,
0327 OCS, OFFSHORE DEVELOPMENT, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, ENVIRONMENTAL MANAGEMENT, BIBLIOGRAPHIES,
0366 OCS, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, U.S. GOVERNMENT, ALASKA,
[illegible] OCS, CARIBBEAN SEA, OFFSHORE PRODUCTION, PIPELINES,
[illegible] OCS, OIL SPILLS, COASTS, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, SOCIO-ECONOMIC EFFECTS,
0356 OCS, LIABILITY, LEGISLATION, U.S., OFFSHORE DEVELOPMENT, DELAWARE, OIL SPILLS, ENVIRONMENTAL PROTECTION,
0363 OCS, OFFSHORE DEVELOPMENT, ATLANTIC COAST, *ONSHORE IMPACTS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
0364 OCS, ENVIRONMENTAL EFFECTS, *ONSHORE EFFECTS, OFFSHORE PRODUCTION, ALASKA/GULF OF, ATLANTIC COAST,
0365 OCS, OFFSHORE DRILLING, PRODUCTION, REGULATIONS, GOVERNMENT AGENCIES, *U.S.G.S.,
0367 OCS, ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, OFFSHORE PRODUCTION, OIL INDUSTRY, COASTS, FISHERIES, SCOTLAND,
0368 OCS, ENVIRONMENTAL EFFECTS, SOCIAL EFFECTS, ENVIRONMENTAL CONSERVATION, OIL INDUSTRY, DEVELOPMENT, SCOTLAND,
0369 OCS, EIS, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING, SANTA BARBARA CHANNEL, *U.S.G.S.,
[illegible] OFFSHORE DEVELOPMENT, BIOLOGICAL EFFECTS, BIRDS, FISHERIES, SCOTLAND, *CONFERENCE,
[illegible] OFFSHORE DEVELOPMENT, MARINE MAMMALS, CONTAMINATION, CRUDE OIL, *RINGED SEALS, BIOLOGICAL EFFECTS,
0327 OFFSHORE DEVELOPMENT, OCS, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, ENVIRONMENTAL MANAGEMENT, BIBLIOGRAPHIES,
0343 OFFSHORE DEVELOPMENT, OFFSHORE DRILLING, EUROPE, OIL TRANSPORT, REGULATIONS, OIL SPILLS,
0366 OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, U.S. GOVERNMENT, ALASKA,
[illegible] OFFSHORE DEVELOPMENT, OCS, OIL SPILLS, COASTS, ENVIRONMENTAL PROTECTION, SOCIO-ECONOMIC EFFECTS,
[illegible] OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, GOVERNMENT AGENCIES, *U.S.G.S.,
0356 OFFSHORE DEVELOPMENT, OCS, LIABILITY, LEGISLATION, U.S., DELAWARE, OIL SPILLS, ENVIRONMENTAL PROTECTION,
[illegible] OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, GOVERNMENT AGENCIES, *U.S. EPA,
[illegible] OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, SAFETY, OFFSHORE PRODUCTION, AUSTRALIA,
[illegible] OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, ATLANTIC COAST, GOVERNMENT AGENCIES, *U.S. BUREAU-LAND MANAGEMENT,
[illegible] OFFSHORE DEVELOPMENT, GUIDELINES, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, COASTS, FLORIDA, *ONSHORE EFFECTS,
0363 OFFSHORE DEVELOPMENT, OCS, ATLANTIC COAST, *ONSHORE IMPACTS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
0367 OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, OFFSHORE PRODUCTION, OIL INDUSTRY, COASTS, FISHERIES, SCOTLAND,
0369 OFFSHORE DEVELOPMENT, OCS, EIS, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING, SANTA BARBARA CHANNEL, *U.S.G.S.,
[illegible] OFFSHORE DEVELOPMENT, FATE, CONTAMINATION, ALASKA/GULF OF, *SEISMICITY, *GROUND SHAKING,
0117 OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION, STATE GOVERNMENTS, ENVIRONMENTAL PROTECTION, PORTS,
0118 OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION, U.S. GOVERNMENT, STATE GOVERNMENTS,
0002 OFFSHORE DRILLING, OCS, ATLANTIC COAST, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
0230 OFFSHORE DRILLING, OCS, CONTINGENCY PLANNING, OIL SPILLS, OIL TRANSPORT, ATLANTIC COAST, *RESEARCH NEEDS, *U.S. EPA,
[illegible] OFFSHORE DRILLING, INDONESIA, OIL SPILLS, COASTS, ENVIRONMENTAL EFFECTS,
[illegible] OFFSHORE DRILLING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS, *DRILLING MUD COMPONENTS,
[illegible] OFFSHORE DRILLING, MARINE ORGANISMS, BIOLOGICAL EFFECTS,
[illegible] OFFSHORE DRILLING, ENVIRONMENTAL EFFECTS, ECONOMICS, EIS, *DRILLING VESSELS,
0343 OFFSHORE DRILLING, OFFSHORE DEVELOPMENT, EUROPE, OIL TRANSPORT, REGULATIONS, OIL SPILLS,
0365 OFFSHORE DRILLING, OCS, PRODUCTION, REGULATIONS, GOVERNMENT AGENCIES, *U.S.G.S.,
[illegible] OFFSHORE DRILLING, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS,
[illegible] OFFSHORE DRILLING, HYDROCARBONS, ADSORPTION, OIL TRANSPORT, *PARTICULATE MATTER,
[illegible] OFFSHORE DRILLING, GUIDELINES, WASTEWATER TREATMENT, REGULATIONS, PRODUCTION,
[illegible] OFFSHORE DRILLING, LIABILITY, INSURANCE, BIBLIOGRAPHIES, *OIL RIG INSURANCE,
[illegible] OFFSHORE DRILLING, BIBLIOGRAPHIES, OIL WELLS, ENVIRONMENTAL EFFECTS,
[illegible] OFFSHORE EXPLORATION, HYDROCARBONS, POLLUTION PREVENTION, MEDITERRANEAN SEA,
[illegible] OFFSHORE EXPLORATION, HYDROCARBONS, HEALTH HAZARDS, OIL SPILLS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, *NEW ENGLAND,
[illegible] OFFSHORE PRODUCTION, NATURAL SEEPAGE, MEXICO/GULF OF, MARINE ORGANISMS, BIOLOGICAL

EFFECTS, VENEZUELA, SANTA BARBARA CHANNEL, TAR, BERMUDA COAST.
[illegible] OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, FISHERIES, CRUDE OIL, TOXICITY, LOUISIANA,
[illegible] OFFSHORE PRODUCTION, MEXICO/GULF OF, GUIDELINES, ECONOMIC EFFECTS, WASTEWATER
TREATMENT, ALASKA, CALIFORNIA.
[illegible] OFFSHORE PRODUCTION, NORTH SEA, MONITORING, OIL SPILLS, BIOLOGICAL EFFECTS, BEHAVIOR,
POLLUTION CONTROL.
[illegible] OFFSHORE PRODUCTION, OCS, CARIBBEAN SEA, PIPELINES.
[illegible] OFFSHORE PRODUCTION, ENVIRONMENTAL PROTECTION, OIL INDUSTRY, *EXXON, OIL SPILLS,
TANKERS.
[illegible] OFFSHORE PRODUCTION, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, SAFETY, AUSTRALIA,
[illegible] OFFSHORE PRODUCTION, OCS, ENVIRONMENTAL EFFECTS, *ONSHORE EFFECTS, ALASKA/GULF OF,
ATLANTIC COAST.
[illegible] OFFSHORE PRODUCTION, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, OIL INDUSTRY,
COASTS, FISHERIES, SCOTLAND.
[illegible] OFFSHORE PRODUCTION, EIS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, OIL SPILLS,
PIPELINES, TANKERS, SANTA BARBARA CHANNEL.
[illegible] OFFSHORE PRODUCTION, OCEANS, LEGISLATION, INTERNATIONAL AGREEMENTS, EUROPE, POLLUTION
PREVENTION, OIL DISCHARGES, CLEANUP.
[illegible] OFFSHORE PRODUCTION, GUIDELINES, REGULATIONS, OIL DISCHARGES, POLLUTION CONTROL, *U.S. EPA
[illegible] OHIO, PIPELINES, CRUDE OIL, *OIL TERMINAL FIRE.
[illegible] OIL DISCHARGES, MEDITERRANEAN SEA, HYDROCARBONS, CONTAMINATION, TANKERS, REFINERIES,
[illegible] OIL DISCHARGES, OCEANS, OIL TRANSPORT, CRUDE OIL, PETROLEUM PRODUCTS, CONSTRUCTION,
[illegible] OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, REFINERIES, OIL
SPILLS, WASHINGTON, CHERRY POINT REFINERY.
[illegible] OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, REFINERIES, OIL
SPILLS, WASHINGTON, *CHERRY POINT REFINERY.
[illegible] OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, REFINERIES, OIL
SPILLS, WASHINGTON, *CHERRY POINT REFINERY.
[illegible] OIL DISCHARGES, MARYLAND, HARBORS, REMOTE SENSING, RIVERS, WASTEWATERS, WATER QUALITY,
[illegible] OIL DISCHARGES, TANKERS, REGULATIONS, SAFETY.
[illegible] OIL DISCHARGES, TANKERS, CONTAMINATION, OIL TRANSPORT, BALLAST, POLLUTION CONTROL,
REGULATIONS.
[illegible] OIL DISCHARGES, OCEANS, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, OIL
SPILLS, WASTEWATERS, *IMCO.
[illegible] OIL DISCHARGES, SHIPS, POLLUTION PREVENTION, *TESTING, *OIL CONTENT METERS.
[illegible] OIL DISCHARGES, LEGISLATION, OIL SPILLS, POLLUTION PREVENTION, POLLUTION CONTROL,
U.S., CANADA, CONTINGENCY PLANNING.
[illegible] OIL DISCHARGES, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, POLLUTION CONTROL,
ENVIRONMENTAL PROTECTION.
[illegible] OIL DISCHARGES, LAKES, WASTEWATERS, BIOLOGICAL EFFECTS, FATE, FISHERIES, VENEZUELA,
ECONOMICS, *LAKE MARACAIBO.
[illegible] OIL DISCHARGES, LAKES, WASTEWATERS, BIOLOGICAL EFFECTS, FISHERIES, VENEZUELA,
ECONOMICS, *LAKE MARACAIBO.
[illegible] OIL DISCHARGES, MODELS, FATE, ESTUARIES.
[illegible] OIL DISCHARGES, LEGISLATION, LAW ENFORCEMENT, U.S., *FWPCA.
[illegible] OIL DISCHARGES, OFFSHORE PRODUCTION, OCEANS, LEGISLATION, INTERNATIONAL AGREEMENTS,
EUROPE, POLLUTION PREVENTION, CLEANUP.
[illegible] OIL DISCHARGES, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, OIL SPILLS.
[illegible] OIL DISCHARGES, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION,
[illegible] OIL DISCHARGES, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, ENVIRONMENTAL
PROTECTION, BALTIC SEA, SHIPS.
[illegible] OIL DISCHARGES, OFFSHORE PRODUCTION, GUIDELINES, REGULATIONS, POLLUTION CONTROL, *U.S. EPA
[illegible] OIL FIELDS, WASTEWATER DISPOSAL, REFINERIES, ENVIRONMENTAL EFFECTS, OIL INDUSTRY,
[illegible] OIL FIELDS, WASTE OIL DISPOSAL, REGULATIONS, STATE GOVERNMENTS, TEXAS.
[illegible] OIL FIELDS, MICROORGANISMS, LOUISIANA, HYDROCARBONS, CHEMICAL EFFECTS, SEDIMENTS,
*PETROLEUM DISSOLUTION.
[illegible] OIL-GAS LEASING, OFFSHORE DEVELOPMENT, OCS, EIS, ENVIRONMENTAL EFFECTS, SANTA BARBARA
CHANNEL, *U.S.G.S.
[illegible] OIL INDUSTRY, RECOVERY, OIL SPILLS, PUGET SOUND, WASHINGTON, *SPILL RECOVERY VESSEL,
[illegible] OIL INDUSTRY, INCINERATION, WASTEWATER TREATMENT, PETROCHEMICALS, OIL-WATER
SEPARATION, OXIDATION, FLOTATION, FILTRATION, ADSORPTION.
[illegible] OIL INDUSTRY, OIL FIELDS, WASTEWATER DISPOSAL, REFINERIES, ENVIRONMENTAL EFFECTS,
[illegible] OIL INDUSTRY, CONTINGENCY PLANNING, OIL SPILLS, BEAUFORT SEA, CANADA, GOVERNMENT
AGENCIES.
[illegible] OIL INDUSTRY, POLLUTION CONTROL, WATER QUALITY, *ON-LINE INSTRUMENTATION.
[illegible] OIL INDUSTRY, ALASKA, PRODUCTION, ECONOMIC EFFECTS.
[illegible] OIL INDUSTRY, REFINERIES, CRUDE OIL, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER
TREATMENT, *U.S. EPA.
[illegible] OIL INDUSTRY, REFINERIES, CRUDE OIL, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER
TREATMENT, *U.S. EPA.
[illegible] OIL INDUSTRY, OIL SPILLS, ENVIRONMENTAL EFFECTS, PRODUCTION, SCOTLAND, *SHETLAND
ISLANDS, *SULLOM VOE.
[illegible] OIL INDUSTRY, OFFSHORE PRODUCTION, ENVIRONMENTAL PROTECTION, *EXXON, OIL SPILLS,
TANKERS.
[illegible] OIL INDUSTRY, OFFSHORE PRODUCTION, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS,

```
     COASTS, FISHERIES, SCOTLAND,
0369 OIL INDUSTRY, GAS, ENVIRONMENTAL EFFECTS, SOCIAL EFFECTS, ENVIRONMENTAL CONSERVATION,
     DEVELOPMENT, SCOTLAND,
[illegible] OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, GROUNDWATER, *STREAMS,
[illegible] OIL SHALE DEVELOPMENT, ENVIRONMENTAL HAZARDS, EXTRACTION, ENVIRONMENTAL PROTECTION,
[illegible] OIL SHALE DEVELOPMENT, ENVIRONMENTAL PROTECTION, WASTEWATERS, POLLUTION CONTROL,
     GOVERNMENT AGENCIES, *U.S. EPA,
[illegible] OIL SHALE DEVELOPMENT, PRODUCTION, EXTRACTION, ENVIRONMENTAL EFFECTS,
[illegible] OIL SLICKS, ESTUARIES, [illegible] RIVER, SOURCE IDENTIFICATION, BIRDS,
[illegible] OIL SLICKS, MONITORING, MARINE ORGANISMS, SAMPLING, TAR, ANALYTICAL TECHNIQUES,
     SEDIMENTS, SEAWATER,
0046 OIL SLICKS, REMOTE SENSING, SPREADING, ANALYTICAL TECHNIQUES, *MICROWAVE RADIOMETRY,
     *IR RADIOMETRY,
0047 OIL SLICKS, MOVEMENT, MODELS, REMOTE SENSING, DELAWARE BAY,
0048 OIL SLICKS, REMOTE SENSING, CONTAINMENT, CLEANUP, *PERFORMANCE TESTS, *MICROWAVE
     EQUIPMENT,
0049 OIL SLICKS, MODELS, REMOTE SENSING, ESTUARIES, DELAWARE BAY, DRIFT, SPREADING, *FRONTS,
0051 OIL SLICKS, REMOTE SENSING, DETECTION, *INFRARED SENSORS,
0053 OIL SLICKS, OCEANS, REMOTE SENSING, EMULSIONS, *THERMAL RADIATION, *FLUID FILMS,
0054 OIL SLICKS, JAPAN SEA OF, REMOTE SENSING, OIL SPILLS, SPREADING,
[illegible] OIL SLICKS, REMOTE SENSING, COASTS, SEDIMENTS, CORAL REEFS, PUERTO RICO, VIRGIN
     ISLANDS, *SLYLAB,
[illegible] OIL SLICKS, REMOTE SENSING, OIL SPILLS, DETECTION, *RADAR,
[illegible] OIL SLICKS, SAMPLING, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROMETRY,
[illegible] OIL SLICKS, SKIMMERS, REFINERIES, RECOVERY, DESIGN-ENGINEERING,
[illegible] OIL SLICKS, HYDROCARBONS, SEDIMENTATION, EVAPORATION, ADSORPTION, *SUBTIDAL
     ENVIRONMENTS,
[illegible] OIL SLICKS, HYDROCARBONS, FATE, WEATHERING, SEDIMENTATION,
[illegible] OIL SLICKS, BEHAVIOR, WEATHERING, SPREADING, EVAPORATION, TAR,
[illegible] OIL SLICKS, FATE, DRIFT, *WIND-WAVE TUNNEL, *WAVE DAMPING,
[illegible] OIL SLICKS, MOVEMENT, MODELS, ST. LAWRENCE RIVER, CANADA,
[illegible] OIL SPILLS, METULA OIL SPILL, MAGELLAN STRAIT OF, BEACHES, TANKERS,
[illegible] OIL SPILLS, TANKERS, *SUPERTANKER ACCIDENTS,
[illegible] OIL SPILLS, INLAND, CRUDE OIL, FUEL OIL, U.S., CANADA,
[illegible] OIL SPILLS, MARINE ORGANISMS, FUEL OIL, CHESAPEAKE BAY, BEACHES, BIRDS, *OIL BARGE,
[illegible] OIL SPILLS, SOURCE IDENTIFICATION, TANKERS, FLORIDA, *U.S. COAST GUARD,
[illegible] OIL SPILLS, UK, CRUDE OIL, *FIRES,
0011 OIL SPILLS, INFORMATION SYSTEMS, POLLUTION PREVENTION, *SPILLS NEWSLETTER,
[illegible] OIL SPILLS, INFORMATION SYSTEMS, CLEANUP, ENVIRONMENTAL PROTECTION, CONTINGENCY
     PLANNING, ECONOMICS, *DATA BASE, *U.S. NAVY,
0015 OIL SPILLS, INFORMATION SYSTEMS, CANADA,
0016 OIL SPILLS, FUEL OIL, ENVIRONMENTAL EFFECTS, BIRDS, SCOTLAND, *SANDS OF FORVIE,
0018 OIL SPILLS, LIABILITY, LEGISLATION, INLAND, POLLUTION PREVENTION, CONTINGENCY
     PLANNING, *REPORTING REQUIREMENTS,
0019 OIL SPILLS, POLLUTION CONTROL, USSR, CLEANUP, BOOMS, SKIMMERS, DISPERSANTS,
0020 OIL SPILLS, MARINE ORGANISMS, TANKERS, CLEANUP, DISPERSANTS, ACUTE EFFECTS, SPAIN,
     *URQUIOLA OIL SPILL,
0022 OIL SPILLS, CRUDE OIL, CLEANUP, UK, *[illegible] STRAIT,
0024 OIL SPILLS, LEGISLATION, JAPAN, CONTAMINATION, BIOLOGICAL EFFECTS, POLLUTION
     PREVENTION,
0032 OIL SPILLS, MONITORING, ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, *LUMINESCENCE
     METHODS,
0038 OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS,
     REFINERIES, WASHINGTON, *CHERRY POINT REFINERY,
0039 OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS,
     REFINERIES, WASHINGTON, *CHERRY POINT REFINERY,
0040 OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS,
     REFINERIES, WASHINGTON, *CHERRY POINT REFINERY,
0041 OIL SPILLS, MONITORING, CONTAMINATION, BIRDS, COASTS, CANADA,
[illegible] OIL SPILLS, REMOTE SENSING, ENVIRONMENTAL PROTECTION, POLLUTION CONTROL,
[illegible] OIL SPILLS, REMOTE SENSING, BALTIC SEA, *MULTISENSOR TECHNIQUE,
[illegible] OIL SPILLS, REMOTE SENSING, *OIL FLUORESCENCE CONVERSION EFFICIENCY,
[illegible] OIL SPILLS, OIL SLICKS, JAPAN SEA OF, REMOTE SENSING, SPREADING,
[illegible] OIL SPILLS, OIL SLICKS, REMOTE SENSING, DETECTION, *RADAR,
[illegible] OIL SPILLS, NATURAL SEEPAGE, REMOTE SENSING, DETECTION, *FRAUNHOFER LINE DISCRIMINATOR,
[illegible] OIL SPILLS, HYDROCARBONS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, *LUMINESCENCE,
[illegible] OIL SPILLS, SOURCE IDENTIFICATION, *SPECTRAL SIGNATURES,
[illegible] OIL SPILLS, SEAWATER, CALIFORNIA, ANALYTICAL TECHNIQUES, *LUMINESCENCE SIGNATURES,
     *LOS ANGELES HARBOR,
0072 OIL SPILLS, ANALYTICAL TECHNIQUES, SOURCE IDENTIFICATION, *SOLVENT COMPENSATION,
0073 OIL SPILLS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, SPECTROMETRY, SAMPLING,
0080 OIL SPILLS, SAMPLING, ANALYTICAL TECHNIQUES, *FLUORESCENCE, *HYDROGEN EXTRACTION,
     SOURCE IDENTIFICATION,
0081 OIL SPILLS, MONITORING, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, REMOTE SENSING,
0082 OIL SPILLS, LUBRICATING OIL, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES,
         *LUMINESCENCE, CRUDE OIL,
0083  OIL SPILLS, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, *PHOSPHORESCENCE,
0084  OIL SPILLS, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, PETROLEUM PRODUCTS, SAMPLING,
0085  OIL SPILLS, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, CHROMATOGRAPHY, STATISTICAL
         ANALYSIS,
0087  OIL SPILLS, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, *FLUORESCENCE SPECTRA,
0088  OIL SPILLS, CONTAINMENT, BOOMS, *MATERIALS EVALUATION,
0089  OIL SPILLS, CONTAINMENT, BOOMS, DESIGN-ENGINEERING,
0090  OIL SPILLS, CONTAINMENT, BOOMS, DESIGN-ENGINEERING,
0091  OIL SPILLS, CONTAINMENT, CLEANUP, BOOMS, DESIGN-ENGINEERING,
0093  OIL SPILLS, OIL INDUSTRY, RECOVERY, PUGET SOUND, WASHINGTON, *SPILL RECOVERY VESSEL,
0094  OIL SPILLS, CLEANUP, RECOVERY, DESIGN-ENGINEERING, *FERROMAGNETIC POLYFOAM CHIPS,
0096  OIL SPILLS, RECOVERY, SKIMMERS, DESIGN-ENGINEERING,
0097  OIL SPILLS, IRELAND, RECOVERY, SKIMMERS, DESIGN-ENGINEERING, BANTRY BAY,
0098  OIL SPILLS, CRUDE OIL, CLEANUP, EVAPORATION, DECOMPOSITION, *LASERS,
0100  OIL SPILLS, CLEANUP, RECOVERY, DESIGN-ENGINEERING, *U.S. NAVY, *POLYURETHANE FOAM
         CHIPS,
0101  OIL SPILLS, NORWEGIAN SEA, CLEANUP, RECOVERY, SKIMMERS, OIL-WATER SEPARATION,
0102  OIL SPILLS, CLEANUP, RECOVERY, ABSORPTION,
0103  OIL SPILLS, RECOVERY, SPAIN, TANKERS, DESIGN-ENGINEERING, *URQUIOLA OIL SPILL,
0104  OIL SPILLS, CLEANUP, RECOVERY, BOOMS, SKIMMERS, DESIGN-ENGINEERING,
0106  OIL SPILLS, CLEANUP, RECOVERY, SKIMMERS, DESIGN-ENGINEERING,
0108  OIL SPILLS, INCINERATION, CLEANUP, DISPOSAL, CANADA,
0109  OIL SPILLS, OIL TRANSFER, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0110  OIL SPILLS, CLEANUP, DISPERSANTS, SURFACTANTS,
0111  OIL SPILLS, CLEANUP, DISPERSANTS, SURFACTANTS,
0112  OIL SPILLS, CLEANUP, RECOVERY, OIL-WATER SEPARATION,
0113  OIL SPILLS, SKIMMERS, RECOVERY, DESIGN-ENGINEERING,
0114  OIL SPILLS, RECOVERY, CLEANUP, DESIGN-ENGINEERING, *EQUIPMENT EVALUATION,
0115  OIL SPILLS, CLEANUP, RECOVERY, ABSORPTION, *POLYETHYLENE FOAM,
0116  OIL SPILLS, RECOVERY, CRUDE OIL, PETROLEUM PRODUCTS, DESIGN-ENGINEERING, *COLD WATER
         RECOVERY,
0118  OIL SPILLS, RECOVERY, OIL-WATER SEPARATION, SKIMMERS, DESIGN-ENGINEERING,
0120  OIL SPILLS, DISPERSANTS, TOXICITY, REGULATIONS, BIBLIOGRAPHIES, CANADA,
0122  OIL SPILLS, SKIMMERS, RECOVERY, DESIGN-ENGINEERING,
0123  OIL SPILLS, RECOVERY, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0124  OIL SPILLS, CLEANUP, RECOVERY, *FERROMAGNETIC GRANULES,
0126  OIL SPILLS, MARINE ORGANISMS, OIL TRANSPORT, ENVIRONMENTAL DETERIORATION, CHRONIC
         EFFECTS,
0132  OIL SPILLS, REGULATIONS, OIL TRANSFER, TOXICITY, *HAZARDOUS MATERIAL SPILLS,
0133  OIL SPILLS, LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS,
         DESIGN-ENGINEERING,
0135  OIL SPILLS, OIL DISCHARGES, OCEANS, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL
         PROTECTION, WASTEWATERS, *IMCO,
0137  OIL SPILLS, REFINERIES, WASTEWATER TREATMENT, PETROCHEMICALS, CONSERVATION, AUSTRALIA,
0160  OIL SPILLS, OIL-WATER SEPARATION, SKIMMERS, DESIGN-ENGINEERING,
0227  OIL SPILLS, CLEANUP, PERSONNEL TRAINING, UK, *POLLUTION CLEANUP FILM,
0228  OIL SPILLS, CONTINGENCY PLANNING, PIPELINES, ALASKA, CLEANUP, RESTORATION,
0229  OIL SPILLS, CONTINGENCY PLANNING, CLEANUP, POLLUTION PREVENTION, TANKERS, GOVERNMENT
         AGENCIES, *U.S.C.G.,
0230  OIL SPILLS, OFFSHORE DRILLING, OCS, CONTINGENCY PLANNING, OIL TRANSPORT, ATLANTIC
         COAST, *RESEARCH NEEDS, *U.S. EPA,
0231  OIL SPILLS, OIL INDUSTRY, CONTINGENCY PLANNING, BEAUFORT SEA, CANADA, GOVERNMENT
         AGENCIES,
0235  OIL SPILLS, POLLUTION PREVENTION, SWEDEN,
0237  OIL SPILLS, LEGISLATION, POLLUTION PREVENTION, STORAGE, DISCHARGES, CONTINGENCY
         PLANNING, *FWPCA,
0238  OIL SPILLS, OCEANS, GOVERNMENT AGENCIES, GERMANY, WEST, POLLUTION PREVENTION, COASTS,
0239  OIL SPILLS, POLLUTION CONTROL, CLEANUP, CONTINGENCY PLANNING, PERSONNEL TRAINING,
0241  OIL SPILLS, OCEANS, POLLUTION PREVENTION, CLEANUP, REGULATIONS, UK,
0243  OIL SPILLS, POLLUTION PREVENTION, CLEANUP, CONTINGENCY PLANNING, AUSTRALIA,
0244  OIL SPILLS, LEGISLATION, INDUSTRIES, POLLUTION PREVENTION, GOVERNMENT AGENCIES,
         CANADA, PERSONNEL TRAINING,
0245  OIL SPILLS, OIL DISCHARGES, LEGISLATION, POLLUTION PREVENTION, POLLUTION CONTROL,
         U.S., CANADA, CONTINGENCY PLANNING,
0246  OIL SPILLS, ARCTIC, CLEANUP, POLLUTION CONTROL, BEAUFORT SEA,
0247  OIL SPILLS, LOUISIANA, COASTS, ENVIRONMENTAL PROTECTION, PORTS,
0249  OIL SPILLS, BLOWOUT PREVENTION, DRILLING, CLEANUP, BEAUFORT SEA, BOOMS, SKIMMERS,
         CONTINGENCY PLANNING,
0250  OIL SPILLS, LIABILITY, REGULATIONS, TANKERS, SAFETY, POLLUTION PREVENTION,
0251  OIL SPILLS, ST. LAWRENCE RIVER, POLLUTION CONTROL, CONTINGENCY PLANNING, PERSONNEL
         TRAINING, CLEANUP, *FIELD TESTS,
0254  OIL SPILLS, ST. LAWRENCE RIVER, GOVERNMENT AGENCIES, U.S., CANADA, CLEANUP,
         RESTORATION, RADIO,
0256  OIL SPILLS, MONITORING, POLLUTION PREVENTION, CONTINGENCY PLANNING, BOOMS, SKIMMERS,
```

0263 OIL SPILLS, MONITORING, MARINE ORGANISMS, ACUTE EFFECTS, CHRONIC EFFECTS, PETROLEUM PRODUCTS, REFINERIES,
0268 OIL SPILLS, MASSACHUSETTS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, *WEST FALMOUTH SPILL,
0270 OIL SPILLS, BIOLOGICAL EFFECTS, FUEL OIL, BIRDS, SCOTLAND, POLLUTION CONTROL, *RIVER TIDAL,
0271 OIL SPILLS, BIOLOGICAL EFFECTS, BIRDS, CANADA, *BAY OF FUNDY, CHRONIC EFFECTS,
0272 OIL SPILLS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, PETROCHEMICALS, [illegible] *LITERATURE REVIEW,
0273 OIL SPILLS, CHRONIC EFFECTS, ACUTE EFFECTS, BIRDS, POLLUTION PREVENTION, CONSERVATION,
0277 OIL SPILLS, CONTAMINATION, CHRONIC EFFECTS, ECOSYSTEMS, EIS, PIPELINES, ALASKA,
0279 OIL SPILLS, MOLLUSKS, METABOLISM, BIOLOGICAL EFFECTS, FUEL OIL, *MYA ARENARIA, *CARBON FLUX,
0280 OIL SPILLS, MARINE ORGANISMS, DISPERSANTS, TOXICITY, ACUTE EFFECTS, CHRONIC EFFECTS,
0284 OIL SPILLS, MODELS, MARINE ORGANISMS, BIOLOGICAL EFFECTS,
0288 OIL SPILLS, ENVIRONMENTAL EFFECTS, ACUTE EFFECTS,
0289 OIL SPILLS, MOLLUSKS, MARINE ORGANISMS, DISPERSANTS, BIOLOGICAL EFFECTS, FRANCE, *NORMAN COAST,
0294 OIL SPILLS, MASSACHUSETTS, MARINE ORGANISMS, INTERTIDAL ZONE, FUEL OIL, EMULSIFIERS, BIOLOGICAL EFFECTS, *WEST FALMOUTH SPILL,
0298 OIL SPILLS, BIOLOGICAL EFFECTS, BACTERIA, ALGAE, FRESHWATER, CANADA,
0303 OIL SPILLS, BIOLOGICAL EFFECTS, BIRDS, CANADA, COASTS,
0309 OIL SPILLS, OFFSHORE DRILLING, INDONESIA, COASTS, ENVIRONMENTAL EFFECTS,
0310 OIL SPILLS, FATE, CRUDE OIL, TANKERS, BEACHES, [illegible] COAST,
0312 OIL SPILLS, WATER QUALITY, ENVIRONMENTAL EFFECTS, ARCTIC, CANADA,
0316 OIL SPILLS, CRUDE OIL, BIOLOGICAL EFFECTS, BEHAVIOR, FATE, CLEANUP,
0317 OIL SPILLS, OFFSHORE EXPLORATION, HYDROCARBONS, HEALTH HAZARDS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, *NEW ENGLAND,
0318 OIL SPILLS, OCEANS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, ANALYTICAL TECHNIQUES, CRUDE OIL, FATE,
0320 OIL SPILLS, ENVIRONMENTAL DETERIORATION, TANKERS,
0322 OIL SPILLS, INTERNATIONAL COOPERATION, TANKERS, ENVIRONMENTAL EFFECTS, POLLUTION CONTROL, CLEANUP, CONTINGENCY PLANNING,
0324 OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, FUEL OIL, SHORELINES, BIODEGRADATION, CANADA, CHEDABUCTO BAY,
0328 OIL SPILLS, OFFSHORE DRILLING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, *DRILLING MUD COMPONENTS,
0332 OIL SPILLS, SOCIAL EFFECTS, ENVIRONMENTAL MANAGEMENT,
0335 OIL SPILLS, MODELS, ECONOMICS, REFINERIES, BIODEGRADATION, CALIFORNIA, *CRUDE OIL SUPPLY,
0340 OIL SPILLS, FISHERIES, CANADA, BIRDS, ECONOMICS, CLEANUP, *BAY OF FUNDY,
0343 OIL SPILLS, OFFSHORE DRILLING, OFFSHORE DEVELOPMENT, EUROPE, OIL TRANSPORT, REGULATIONS,
0346 OIL SPILLS, OIL INDUSTRY, ENVIRONMENTAL EFFECTS, PRODUCTION, SCOTLAND, *SHETLAND ISLANDS, *SULLOM VOE,
0347 OIL SPILLS, OFFSHORE PRODUCTION, NORTH SEA, MONITORING, BIOLOGICAL EFFECTS, BEHAVIOR, POLLUTION CONTROL,
0350 OIL SPILLS, OIL INDUSTRY, OFFSHORE PRODUCTION, ENVIRONMENTAL PROTECTION, *EXXON, TANKERS,
0352 OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, COASTS, ENVIRONMENTAL PROTECTION, SOCIO-ECONOMIC EFFECTS,
0355 OIL SPILLS, MOVEMENT, DRILLING, BEAUFORT SEA, CANADA, *OIL-ON-ICE,
0366 OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, LIABILITY, LEGISLATION, U.S., DELAWARE, ENVIRONMENTAL PROTECTION,
0371 OIL SPILLS, OFFSHORE PRODUCTION, OCS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, PIPELINES, TANKERS, SANTA BARBARA CHANNEL,
0374 OIL SPILLS, MICROORGANISMS, BIODEGRADATION, CLEANUP, *NUTRIENT ADDITION,
0376 OIL SPILLS, BIODEGRADATION, CLEANUP, BALLAST, BILGES, OIL TANKS, WASTEWATER TREATMENT, RECLAMATION, [illegible]
0377 OIL SPILLS, MONITORING, MICROORGANISMS, BIODEGRADATION, CRUDE OIL, BACTERIA, CLEANUP,
0383 OIL SPILLS, MICROORGANISMS, HYDROCARBONS, BIODEGRADATION, *CELLULOSIC SUBSTRATES,
0391 OIL SPILLS, MARINE ORGANISMS, BEHAVIOR, *FREEZING CONDITIONS, EVAPORATION, BIOLOGICAL EFFECTS,
0392 OIL SPILLS, FATE, BEHAVIOR, BEACHES, SEDIMENTS, CANADA, *NOVA SCOTIA,
0395 OIL SPILLS, MODELS, FATE, DRIFT, *DISCRETE-PARCEL-RANDOM-WALK MODEL,
0397 OIL SPILLS, HYDROCARBONS, FATE, DISTRIBUTION, *SALT MARSH, BIOLOGICAL EFFECTS,
0406 OIL SPILLS, HYDROCARBONS, FATE, DISPERSION, GROUNDWATER,
0412 OIL SPILLS, OCEANS, HYDROCARBONS, TAR, SOURCE IDENTIFICATION, PLANTS, FATE,
0415 OIL SPILLS, OCEANS, FATE, BIBLIOGRAPHIES, *PHYSICAL CHANGES, *CHEMICAL CHANGES,
0419 OIL SPILLS, LIABILITY, LEGISLATION, U.S., *COMPENSATION,
0421 OIL SPILLS, LIABILITY, LEGISLATION, *PRIVATE DAMAGE SUITS, U.S.,
0427 OIL SPILLS, OIL DISCHARGES, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION,
0428 OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS, SHIPS,
0430 OIL SPILLS, OCEANS, INTERNATIONAL CONVENTIONS, CONTAMINATION, ENVIRONMENTAL EFFECTS, [illegible]
0432 OIL SPILLS, LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, *U.N. LAW OF THE SEA,

0322 OIL SPILLS; LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, ECONOMICS,
0435 OIL SPILLS; MANUALS, GUIDELINES, POLLUTION PREVENTION, CONTAINMENT, CLEANUP,
0438 OIL SPILLS; MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, PETROCHEMICALS,
PUGET SOUND,
0561 OIL SPILLS; BIBLIOGRAPHIES, ENVIRONMENTAL EFFECTS,
0665 OIL SPILLS; MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL
EFFECTS, TOXICITY,
0666 OIL SPILLS; MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL
EFFECTS, BIODEGRADATION, *TROPICAL WATERS
0667 OIL SPILLS; BIBLIOGRAPHIES, CLEANUP, RECOVERY, OIL-WATER SEPARATION, SKIMMERS,
ADSORPTION, DISPERSANTS, FLOTATION,
0095 OIL TANKS; WASTEWATER TREATMENT, CLEANUP, OIL-WATER SEPARATION, REUSE,
0121 OIL TANKS; CLEANUP, CONTAMINATION, STORAGE, *RESIDUAL OIL, EMULSIFICATION,
0131 OIL TANKS; STORAGE, POLLUTION PREVENTION, *ACOUSTIC EMISSION METHODS,
1376 OIL TANKS; OIL SPILLS, BIODEGRADATION, CLEANUP, BALLAST, BILGES, WASTEWATER TREATMENT,
RECLAMATION, PETROLEUM PRODUCTS,
0023 OIL TANKS; LEGISLATION, U.S., STORAGE, CRUDE OIL, EIS, ENVIRONMENTAL EFFECTS,
0105 OIL TRANSFER; OIL SPILLS, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0130 OIL TRANSFER; PORTS, *RISK ANALYSIS,
0132 OIL TRANSFER; OIL SPILLS, REGULATIONS, TOXICITY, *HAZARDOUS MATERIAL SPILLS,
0135 OIL TRANSFER; *OIL TERMINAL, ENVIRONMENTAL EFFECTS, SCOTLAND, *SULLOM VOE,
0275 OIL TRANSFER; POLLUTION PREVENTION, CRUDE OIL, DESIGN-ENGINEERING, *AFLOTE OIL HOSE,
0370 OIL TRANSFER; ENVIRONMENTAL EFFECTS, OIL TRANSPORT, PIPELINES, TANKERS,
0021 OIL TRANSPORT; OIL DISCHARGES, OCEANS, CRUDE OIL, PETROLEUM PRODUCTS, CARCINOGENS,
0127 OIL TRANSPORT; U.S., STORAGE, TANKERS, PORTS, ECONOMICS, ENVIRONMENTAL EFFECTS,
0128 OIL TRANSPORT; OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL DETERIORATION, CHRONIC
EFFECTS,
0129 OIL TRANSPORT; OIL DISCHARGES, TANKERS, CONTAMINATION, BALLAST, POLLUTION CONTROL,
REGULATIONS,
0230 OIL TRANSPORT; OIL SPILLS, OFFSHORE DRILLING, OCS, CONTINGENCY PLANNING, ATLANTIC
COAST, *RESEARCH NEEDS, *U.S. EPA,
0315 OIL TRANSPORT; POLLUTION CONTROL, STORAGE, PRODUCTION, STATISTICS,
0363 OIL TRANSPORT; OIL SPILLS, OFFSHORE DRILLING, OFFSHORE DEVELOPMENT, EUROPE,
REGULATIONS,
0370 OIL TRANSPORT; OIL TRANSFER, ENVIRONMENTAL EFFECTS, PIPELINES, TANKERS,
0616 OIL TRANSPORT; OFFSHORE DRILLING, HYDROCARBONS, ADSORPTION, *PARTICULATE MATTER,
0083 OIL-WATER SEPARATION; MONITORING, ANALYTICAL TECHNIQUES, DESIGN-ENGINEERING,
0095 OIL-WATER SEPARATION; OIL TANKS, WASTEWATER TREATMENT, CLEANUP, REUSE,
0101 OIL-WATER SEPARATION; OIL SPILLS, NORWEGIAN SEA, CLEANUP, RECOVERY, SKIMMERS,
0105 OIL-WATER SEPARATION; OIL TRANSFER, OIL SPILLS, DESIGN-ENGINEERING,
0112 OIL-WATER SEPARATION; OIL SPILLS, CLEANUP, RECOVERY,
0118 OIL-WATER SEPARATION; OIL SPILLS, RECOVERY, SKIMMERS, DESIGN-ENGINEERING,
0119 OIL-WATER SEPARATION; HYDROCARBONS, RECOVERY, ABSORPTION, *OLEOPHILIC MATERIAL,
0122 OIL-WATER SEPARATION; OIL SPILLS, RECOVERY, DESIGN-ENGINEERING,
0138 OIL-WATER SEPARATION; JAPAN, WASTEWATER TREATMENT, BILGES, TANKERS,
0139 OIL-WATER SEPARATION; WASTEWATER TREATMENT, DESIGN-ENGINEERING, *FLOATABLE BARGES,
0140 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, FILTRATION, *ULTRAFILTRATION,
0141 OIL-WATER SEPARATION; WASTE OIL TREATMENT, EMULSIONS, DESIGN-ENGINEERING,
0142 OIL-WATER SEPARATION; WASTEWATER TREATMENT, DESIGN-ENGINEERING,
0143 OIL-WATER SEPARATION; WASTEWATER TREATMENT, COALESCENCE, DESIGN-ENGINEERING,
0145 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS,
0145 OIL-WATER SEPARATION; WASTEWATER TREATMENT, SHIPS,
0146 OIL-WATER SEPARATION; WASTEWATER TREATMENT, COALESCENCE, WASTEWATER DISPOSAL, BILGES,
BALLAST,
0148 OIL-WATER SEPARATION, WASTEWATER TREATMENT, TANKERS, REFINERIES, OIL WELLS,
DESIGN-ENGINEERING,
0155 OIL-WATER SEPARATION; WASTE OIL TREATMENT, WASTEWATER TREATMENT,
0156 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, *CATIONIC POLYMERS,
0157 OIL-WATER SEPARATION, WASTEWATER TREATMENT, DETECTION, CONTAMINATION,
DESIGN-ENGINEERING,
0159 OIL-WATER SEPARATION, HYDROCARBONS, WASTEWATER TREATMENT, *SOLVENT EXTRACTION,
0160 OIL-WATER SEPARATION; OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0161 OIL-WATER SEPARATION, OIL INDUSTRY, INCINERATION, WASTEWATER TREATMENT,
PETROCHEMICALS, OXIDATION, FLOTATION, FILTRATION, ADSORPTION,
0163 OIL-WATER SEPARATION; WASTEWATER TREATMENT, SHIPS, BALLAST, DESIGN-ENGINEERING,
0165 OIL-WATER SEPARATION; WASTEWATER TREATMENT, COAGULATION, OXIDATION, SLUDGE,
0166 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, PH CONTROL,
0168 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, *ULTRAFILTRATION MEMBRANES,
0171 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, TANKERS, FLOCCULATION,
0173 OIL-WATER SEPARATION; BILGES, SHIPS, WASTEWATER TREATMENT,
0175 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, DESIGN-ENGINEERING,
0176 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS, SKIMMERS, ECONOMICS,
0176 OIL-WATER SEPARATION; WASTEWATER TREATMENT, EMULSIONS,
0194 OIL-WATER SEPARATION; WASTEWATER TREATMENT, REFINERIES, USSR,
0194 OIL-WATER SEPARATION; WASTE OIL, BILGES, DESIGN-ENGINEERING,

0180 OIL-WATER SEPARATION, WASTEWATER TREATMENT, DISPERSIONS, COALESCENCE, *SULFUR,
0181 OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,
0182 OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION, ADSORPTION,
0186 OIL-WATER SEPARATION, WASTEWATER TREATMENT, COALESCENCE, *OIL WETTABILITY,
0187 OIL-WATER SEPARATION, WASTEWATER TREATMENT, COALESCENCE, EMULSIONS, DESIGN-ENGINEERING,
0193 OIL-WATER SEPARATION, INCINERATION, WASTEWATER TREATMENT, EMULSIONS, FILTRATION, FUEL OIL,
0194 OIL-WATER SEPARATION, WASTEWATER TREATMENT, DESIGN-ENGINEERING, *COANDA EFFECT,
0195 OIL-WATER SEPARATION, LUBRICATING OIL, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION, FILTRATION,
0196 OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FILTRATION,
0198 OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES, PH CONTROL, OXIDATION, FLOCCULATION,
0203 OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES,
0204 OIL-WATER SEPARATION, PETROLEUM PRODUCTS, ADSORPTION, *SKIMMING,
0205 OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COAGULATION, FLOCCULATION, FILTRATION,
0206 OIL-WATER SEPARATION, WASTEWATER TREATMENT, FILTRATION, PH CONTROL,
0208 OIL-WATER SEPARATION, WASTE OIL TREATMENT, EMULSIONS,
0209 OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COAGULATION,
0212 OIL-WATER SEPARATION, WASTEWATERS, WASTE OIL, RECLAMATION, REUSE,
0667 OIL-WATER SEPARATION, OIL SPILLS, BIBLIOGRAPHIES, CLEANUP, RECOVERY, SKIMMERS, ADSORPTION, DISPERSANTS, FLOTATION,
0198 OIL WELLS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, TANKERS, REFINERIES, DESIGN-ENGINEERING,
0252 OIL WELLS, BLOWOUT PREVENTION, DETECTION, POLLUTION PREVENTION, DRILLING,
0255 OIL WELLS, POLLUTION PREVENTION, BLOWOUT PREVENTION, DRILLING,
0752 OIL WELLS, OFFSHORE DRILLING, BIBLIOGRAPHIES, ENVIRONMENTAL EFFECTS,
0156 OXIDATION, REFINERIES, WASTEWATER TREATMENT, ECONOMICS, PETROCHEMICALS,
0163 OXIDATION, OIL-WATER SEPARATION, OIL INDUSTRY, INCINERATION, WASTEWATER TREATMENT, PETROCHEMICALS, FLOTATION, FILTRATION, ADSORPTION,
0165 OXIDATION, OIL-WATER SEPARATION, WASTEWATER TREATMENT, COAGULATION, SLUDGE,
0150 OXIDATION, WASTEWATER TREATMENT, PETROLEUM PRODUCTS, FILTRATION,
0197 OXIDATION, WASTEWATER TREATMENT, REFINERIES, PH CONTROL, FLOCCULATION, FLOTATION,
0198 OXIDATION, OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES, PH CONTROL, FLOCCULATION,
0378 OXIDATION, MONITORING, MICROORGANISMS, BIODEGRADATION, CRUDE OIL, BEACHES,
0042 PACIFIC OCEAN, OCEANS, MONITORING, TAR, DISTRIBUTION,
0019 PAH, HEALTH HAZARDS, CONTAMINATION, *FOODS, CARCINOGENS,
0067 PAH, MONITORING, MARINE ORGANISMS, CHEMICAL ANALYSIS, *BENZO(A)PYRENE, CHROMATOGRAPHY, *FLUORIMETRY, SEDIMENTS,
0068 PAH, HYDROCARBONS, ALGAE, SAN FRANCISCO BAY, CARCINOGENS, ESTUARIES, FOOD WEB, CALIFORNIA,
0069 PAH, CHEMICAL ANALYSIS, CHROMATOGRAPHY, PETROLEUM PRODUCTS, GASOLINE,
0075 PAH, FISHES, CHEMICAL ANALYSIS, CHROMATOGRAPHY, CONTAMINATION,
0079 PAH, MARINE ORGANISMS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, *SHELLFISH,
0276 PAH, MARINE ORGANISMS, BIOLOGICAL EFFECTS, ECHINODERMS, *EGG DEVELOPMENT,
0301 PAH, HYDROCARBONS, FATE, CRUDE OIL, ALGAE, SEDIMENTS, ESTUARIES, ENGLAND, *DIATOMS,
0361 PAH, MICROORGANISMS, BIODEGRADATION, AROMATIC HYDROCARBONS, SOIL, *WATERS,
0613 PAH, OIL SPILLS, OCEANS, HYDROCARBONS, SOURCE IDENTIFICATION, PLANTS, FATE,
0227 PERSONNEL TRAINING, OIL SPILLS, CLEANUP, UK, *POLLUTION CLEANUP FILM,
0239 PERSONNEL TRAINING, OIL SPILLS, POLLUTION CONTROL, CLEANUP, CONTINGENCY PLANNING,
0244 PERSONNEL TRAINING, OIL SPILLS, LEGISLATION, INDUSTRIES, POLLUTION PREVENTION, GOVERNMENT AGENCIES, CANADA,
0251 PERSONNEL TRAINING, OIL SPILLS, ST. LAWRENCE RIVER, POLLUTION CONTROL, CONTINGENCY PLANNING, CLEANUP, *FIELD TESTS,
0025 PETROCHEMICALS, MONITORING, REFINERIES, VENEZUELA, ENVIRONMENTAL EFFECTS, *BASELINE STUDIES,
0157 PETROCHEMICALS, OIL SPILLS, REFINERIES, WASTEWATER TREATMENT, CONSERVATION, AUSTRALIA,
0152 PETROCHEMICALS, LEGISLATION, INDUSTRIES, POLLUTION PREVENTION, WASTEWATER TREATMENT, SOCIO-ECONOMIC EFFECTS, ECONOMICS,
0156 PETROCHEMICALS, OXIDATION, REFINERIES, WASTEWATER TREATMENT, ECONOMICS,
0163 PETROCHEMICALS, OXIDATION, OIL-WATER SEPARATION, OIL INDUSTRY, INCINERATION, WASTEWATER TREATMENT, FLOTATION, FILTRATION, ADSORPTION,
0226 PETROCHEMICALS, MANUALS, INDUSTRIES, RECYCLING, SOLID WASTES, WASTEWATERS, WASTE OIL,
0272 PETROCHEMICALS, OIL SPILLS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, PUGET SOUND, *LITERATURE REVIEW,
0362 PETROCHEMICALS, BIODEGRADATION, CRUDE OIL, BACTERIA,
0638 PETROCHEMICALS, OIL SPILLS, MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, PUGET SOUND,
0639 PETROCHEMICALS, INDUSTRIES, BIBLIOGRAPHIES, WASTEWATER TREATMENT, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0888 PETROCHEMICALS, INDUSTRIES, BIBLIOGRAPHIES, WASTEWATER TREATMENT, ECONOMICS, *INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0021 PETROLEUM PRODUCTS, OIL TRANSPORT, OIL DISCHARGES, OCEANS, CRUDE OIL, CARCINOGENS,

0036 PETROLEUM PRODUCTS, MONITORING, REMOTE SENSING, CONTAMINANTS, WATER QUALITY, *AIR
QUALITY.
0069 PETROLEUM PRODUCTS, PAH, CHEMICAL ANALYSIS, CHROMATOGRAPHY, GASOLINE.
0086 PETROLEUM PRODUCTS, OIL SPILLS, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, SAMPLING.
0092 PETROLEUM PRODUCTS, CONTAINMENT, FUELS, STORAGE, ARCTIC, *SPILL CONTAINMENT DIKES.
0116 PETROLEUM PRODUCTS, OIL SPILLS, RECOVERY, CRUDE OIL, DESIGN-ENGINEERING, *COLD WATER
RECOVERY.
0125 PETROLEUM PRODUCTS, LEAKAGE, STORAGE, CRUDE OIL, SAFETY, ECONOMICS, *UNDERGROUND SALT
CAVERNS.
0176 PETROLEUM PRODUCTS, WASTEWATER TREATMENT, REFINERIES.
0183 PETROLEUM PRODUCTS, WASTEWATER TREATMENT, RECOVERY, CONTAMINANTS.
0186 PETROLEUM PRODUCTS, OXIDATION, WASTEWATER TREATMENT, FILTRATION.
0202 PETROLEUM PRODUCTS, HYDROCARBONS, WASTEWATER TREATMENT, REFINERIES.
0204 PETROLEUM PRODUCTS, OIL-WATER SEPARATION, ADSORPTION, *SKIMMING.
0263 PETROLEUM PRODUCTS, OIL SPILLS, MONITORING, MARINE ORGANISMS, ACUTE EFFECTS, CHRONIC
EFFECTS, REFINERIES.
0282 PETROLEUM PRODUCTS, BIOLOGICAL EFFECTS, CONTAMINATION, CRUDE OIL, FRESHWATER, CANADA,
*CHIRONOMIDAE.
0376 PETROLEUM PRODUCTS, OIL TANKS, OIL SPILLS, BIODEGRADATION, CLEANUP, BALLAST, BILGES,
WASTEWATER TREATMENT, RECLAMATION.
0166 PH CONTROL, OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS.
0192 PH CONTROL, WASTEWATER TREATMENT, REFINERIES, FLOCCULATION, SEDIMENTATION.
0197 PH CONTROL, OXIDATION, WASTEWATER TREATMENT, REFINERIES, FLOCCULATION, FLOTATION.
0198 PH CONTROL, OXIDATION, OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES,
FLOCCULATION.
0207 PH CONTROL, OIL-WATER SEPARATION, WASTEWATER TREATMENT, FILTRATION.
0269 PHYTOPLANKTON, HYDROCARBONS, BIOLOGICAL EFFECTS, ZOOPLANKTON, BENTHOS, WATER QUALITY,
GASOLINE, *MARINE ENGINE EMISSIONS.
0006 PHYTOPLANKTON, METABOLISM, INVERTEBRATES, HYDROCARBONS, FATE, ZOOPLANKTON, FISHES.
0026 PIPELINES, OIL SPILLS, CONTINGENCY PLANNING, ALASKA, CLEANUP, RESTORATION.
0033 PIPELINES, OIL SPILLS, CONTAMINATION, CHRONIC EFFECTS, ECOSYSTEMS, EIS, ALASKA.
0370 PIPELINES, OIL TRANSPORT, OIL TRANSFER, ENVIRONMENTAL EFFECTS, TANKERS.
0371 PIPELINES, OIL SPILLS, OFFSHORE PRODUCTION, EIS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC
EFFECTS, TANKERS, SANTA BARBARA CHANNEL.
0030 PLANTS, TOXICITY, *FORMATION FLUIDS, DRILLING, *LAND ANIMALS.
0013 PLANTS, PAH, OIL SPILLS, OCEANS, HYDROCARBONS, SOURCE IDENTIFICATION, FATE.
0316 POLLUTION CONTROL, OIL SPILLS, USSR, CLEANUP, BOOMS, SKIMMERS, DISPERSANTS.
0094 POLLUTION CONTROL, OIL SPILLS, REMOTE SENSING, ENVIRONMENTAL PROTECTION.
0120 POLLUTION CONTROL, OIL TRANSPORT, OIL DISCHARGES, TANKERS, CONTAMINATION, BALLAST,
REGULATIONS.
0151 POLLUTION CONTROL, REFINERIES, WASTEWATER TREATMENT, *PURIFICATION.
0161 POLLUTION CONTROL, REFINERIES, WASTEWATERS, BELGIUM.
0172 POLLUTION CONTROL, WASTEWATER TREATMENT, WASTE OIL TREATMENT.
0193 POLLUTION CONTROL, WASTEWATER TREATMENT, REFINERIES.
0235 POLLUTION CONTROL, PERSONNEL TRAINING, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING.
0280 POLLUTION CONTROL, OIL INDUSTRY, WATER QUALITY, *ON-LINE INSTRUMENTATION.
0261 POLLUTION CONTROL, OIL SPILLS, OIL DISCHARGES, LEGISLATION, POLLUTION PREVENTION,
U.S., CANADA, CONTINGENCY PLANNING.
0246 POLLUTION CONTROL, OIL SPILLS, ARCTIC, CLEANUP, BEAUFORT SEA.
0251 POLLUTION CONTROL, PERSONNEL TRAINING, OIL SPILLS, ST. LAWRENCE RIVER, CONTINGENCY
PLANNING, CLEANUP, *FIELD TESTS.
0287 POLLUTION CONTROL, OIL DISCHARGES, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS,
ENVIRONMENTAL PROTECTION.
0252 POLLUTION CONTROL, REFINERIES, ENVIRONMENTAL PROTECTION, CARIBBEAN SEA.
0276 POLLUTION CONTROL, OIL SPILLS, BIOLOGICAL EFFECTS, FUEL OIL, BIRDS, SCOTLAND, *RIVER
YTHAN.
0315 POLLUTION CONTROL, OIL TRANSPORT, STORAGE, PRODUCTION, STATISTICS.
0327 POLLUTION CONTROL, OIL SPILLS, INTERNATIONAL CONVENTIONS, TANKERS, ENVIRONMENTAL
EFFECTS, CLEANUP, CONTINGENCY PLANNING.
0347 POLLUTION CONTROL, OIL SPILLS, OFFSHORE PRODUCTION, NORTH SEA, MONITORING, BIOLOGICAL
EFFECTS, BEHAVIOR.
0362 POLLUTION CONTROL, OIL SHALE DEVELOPMENT, ENVIRONMENTAL PROTECTION, WASTEWATERS,
GOVERNMENT AGENCIES, *U.S. EPA.
0037 POLLUTION CONTROL, OIL DISCHARGES, OFFSHORE PRODUCTION, GUIDELINES, REGULATIONS, *U.S. EPA
0011 POLLUTION PREVENTION, OIL SPILLS, INFORMATION SYSTEMS, *SPILLS NEWSLETTER.
0016 POLLUTION PREVENTION, OIL SPILLS, LIABILITY, LEGISLATION, INLAND, CONTINGENCY
PLANNING, *REPORTING REQUIREMENTS.
0021 POLLUTION PREVENTION, OIL SPILLS, LEGISLATION, JAPAN, CONTAMINATION, BIOLOGICAL
EFFECTS.
0121 POLLUTION PREVENTION, OIL TANKS, STORAGE, *ACOUSTIC EMISSION METHODS.
0162 POLLUTION PREVENTION, PETROCHEMICALS, LEGISLATION, INDUSTRIES, WASTEWATER TREATMENT,
SOCIO-ECONOMIC EFFECTS, ECONOMICS.
0190 POLLUTION PREVENTION, OIL DISCHARGES, SHIPS, *TESTING, *OIL CONTENT METERS.
0220 POLLUTION PREVENTION, OIL SPILLS, CONTINGENCY PLANNING, CLEANUP, TANKERS, GOVERNMENT
AGENCIES, *U.S.C.G.

0232 POLLUTION PREVENTION; LAW ENFORCEMENT, REGULATIONS, *CIVIL PENALTIES, U.S., SEA,
0233 POLLUTION PREVENTION; OIL TRANSFER, CRUDE OIL, DESIGN-ENGINEERING, [illegible]
0235 POLLUTION PREVENTION; OIL SPILLS, AMOCO,
0236 POLLUTION PREVENTION; OFFSHORE EXPLORATION, HYDROCARBONS, MEDITERRANEAN SEA,
0237 POLLUTION PREVENTION; OIL SPILLS, LEGISLATION, STORAGE, DISCHARGES, CONTINGENCY PLANNING, [illegible]
0238 POLLUTION PREVENTION; OIL SPILLS, OCEANS, GOVERNMENT AGENCIES, GERMANY, WEST, COASTS,
0261 POLLUTION PREVENTION; OIL SPILLS, OCEANS, CLEANUP, REGULATIONS, UK,
0262 POLLUTION PREVENTION; OIL WELLS, BLOWOUT PREVENTION, DETECTION, DRILLING,
0263 POLLUTION PREVENTION; OIL SPILLS, CLEANUP, CONTINGENCY PLANNING, AUSTRALIA,
0264 POLLUTION PREVENTION; PERSONNEL TRAINING, OIL SPILLS, LEGISLATION, INDUSTRIES, GOVERNMENT AGENCIES, CANADA,
0265 POLLUTION PREVENTION; POLLUTION CONTROL, OIL SPILLS, OIL DISCHARGES, LEGISLATION, U.S., CANADA, CONTINGENCY PLANNING,
0248 POLLUTION PREVENTION; INTERNATIONAL CONVENTIONS, HYDROCARBONS,
0250 POLLUTION PREVENTION; OIL SPILLS, LIABILITY, REGULATIONS, TANKERS, SAFETY,
0255 POLLUTION PREVENTION; OIL WELLS, BLOWOUT PREVENTION, DRILLING,
0266 POLLUTION PREVENTION; OIL SPILLS, MONITORING, CONTINGENCY PLANNING, BOOMS, SKIMMERS,
0273 POLLUTION PREVENTION; OIL SPILLS, CHRONIC EFFECTS, ACUTE EFFECTS, PIPES, CONSERVATION,
0424 POLLUTION PREVENTION; SHIPS, DESIGN-ENGINEERING, *INTERNATIONAL LAW,
0425 POLLUTION PREVENTION; LIABILITY, LEGISLATION, ENVIRONMENTAL PROTECTION,
0426 POLLUTION PREVENTION; OIL DISCHARGES, OFFSHORE PRODUCTION, OCEANS, LEGISLATION, INTERNATIONAL AGREEMENTS, EUROPE, CLEANUP,
0427 POLLUTION PREVENTION; OIL SPILLS, OIL DISCHARGES, INTERNATIONAL CONVENTIONS,
0429 POLLUTION PREVENTION; OIL DISCHARGES, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS,
0431 POLLUTION PREVENTION; LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INTERNATIONAL AGREEMENTS, SHIPS, ECONOMICS,
0432 POLLUTION PREVENTION; OIL DISCHARGES, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, BALTIC SEA, SHIPS,
0433 POLLUTION PREVENTION; OIL SPILLS, MANUALS, GUIDELINES, CONTAINMENT, CLEANUP,
0293 POLYCHAETES, HYDROCARBONS, BIOLOGICAL EFFECTS, FATE, *NEANTHES ARENACEODENTATA,
0306 POLYCHAETES, METABOLISM, BIOLOGICAL EFFECTS, CRUDE OIL, *NEANTHES ARENACEODENTATA,
0127 PORTS, OIL TRANSPORT, U.S., STORAGE, TANKERS, ECONOMICS, ENVIRONMENTAL EFFECTS,
0170 PORTS, OIL TRANSFER, *RISK ANALYSIS,
0247 PORTS, OIL SPILLS, LOUISIANA, COASTS, ENVIRONMENTAL PROTECTION,
0339 PORTS, OIL SPILLS, FISHERIES, CANADA, ECONOMICS, CLEANUP, *BAY OF FUNDY,
0417 PORTS, OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION, STATE GOVERNMENTS, ENVIRONMENTAL PROTECTION,
0443 PORTS, BIBLIOGRAPHIES, TANKERS, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS,
0444 PORTS, BIBLIOGRAPHIES, TANKERS, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS,
0336 PRODUCTION, OIL INDUSTRY, ALASKA, ECONOMIC EFFECTS,
0361 PRODUCTION, TAR SANDS, CONTAMINATION, WATER QUALITY, CANADA, *ATHABASCA OIL SANDS,
0362 PRODUCTION, TAR SANDS, EXTRACTION, ENVIRONMENTAL EFFECTS, WASTEWATER DISPOSAL,
0365 PRODUCTION, OIL SHALE DEVELOPMENT, EXTRACTION, ENVIRONMENTAL EFFECTS,
0366 PRODUCTION, OFFSHORE DRILLING, OCS, REGULATIONS, GOVERNMENT AGENCIES, *U.S.G.S.,
0436 PRODUCTION, OFFSHORE DRILLING, GUIDELINES, WASTEWATER TREATMENT, REGULATIONS,
0351 PRUDHOE BAY, MARINE ORGANISMS, HYDROCARBONS, SEDIMENTS, COASTS, ALASKA,
0055 PUERTO RICO, OIL SLICKS, REMOTE SENSING, COASTS, SEDIMENTS, CORAL REEFS, VIRGIN ISLANDS, *SKYLAB,
0093 PUGET SOUND, OIL SPILLS, OIL INDUSTRY, RECOVERY, WASHINGTON, *SPILL RECOVERY VESSEL,
0272 PUGET SOUND, PETROCHEMICALS, OIL SPILLS, MARINE ORGANISMS, BIOLOGICAL EFFECTS, *LITERATURE REVIEW,
0435 PUGET SOUND, PETROCHEMICALS, OIL SPILLS, MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS,
0162 RECLAMATION, LUBRICATING OIL, WASTE OIL TREATMENT, DISPOSAL, ENVIRONMENTAL EFFECTS,
0211 RECLAMATION, WASTE OIL, DESIGN-ENGINEERING,
0212 RECLAMATION, OIL-WATER SEPARATION, WASTEWATERS, WASTE OIL, REUSE,
0213 RECLAMATION, LUBRICATING OIL, WASTE OIL, FUEL OIL, CRANKCASE OIL,
0215 RECLAMATION, LUBRICATING OIL, CRANKCASE OIL, RECYCLING,
0217 RECLAMATION, WASTE OIL, REFINING, UK,
0218 RECLAMATION, LUBRICATING OIL, WASTE OIL, REFINING,
0219 RECLAMATION, INDIA, CRANKCASE OIL, REFINING,
0220 RECLAMATION, JAPAN, WASTE OIL TREATMENT, REFINING,
0221 RECLAMATION, LUBRICATING OIL, JAPAN, WASTE OIL TREATMENT, REFINING, SOLVENTS,
0222 RECLAMATION, WASTE OIL, ENVIRONMENTAL EFFECTS, FRESHWATER, SEAWATER, RECYCLING, UK,
0224 RECLAMATION, LUBRICATING OIL, REUSE, WASTE OIL, FUELS,
0374 RECLAMATION, PETROLEUM PRODUCTS, OIL TANKS, OIL SPILLS, BIODEGRADATION, CLEANUP, BALLAST, BILGES, WASTEWATER TREATMENT,
0093 RECOVERY, PUGET SOUND, OIL SPILLS, OIL INDUSTRY, WASHINGTON, *SPILL RECOVERY VESSEL,
0094 RECOVERY, OIL SPILLS, CLEANUP, DESIGN-ENGINEERING, *FERROMAGNETIC POLYFOAM CHIPS,
0096 RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0097 RECOVERY, OIL SPILLS, IRELAND, SKIMMERS, DESIGN-ENGINEERING, BANTRY BAY,
0100 RECOVERY, OIL SPILLS, CLEANUP, DESIGN-ENGINEERING, *U.S. NAVY, *POLYURETHANE FOAM USED
0101 RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, NORWEGIAN SEA, CLEANUP, SKIMMERS,

0102 RECOVERY, OIL SPILLS, CLEANUP, ABSORPTION,
0103 RECOVERY, OIL SPILLS, SPAIN, TANKERS, DESIGN-ENGINEERING, *URQUIOLA OIL SPILL,
0105 RECOVERY, OIL SPILLS, CLEANUP, BOOMS, SKIMMERS, DESIGN-ENGINEERING,
0108 RECOVERY, OIL SLICKS, SKIMMERS, REFINERIES, DESIGN-ENGINEERING,
0109 RECOVERY, OIL SPILLS, CLEANUP, SKIMMERS, DESIGN-ENGINEERING,
0111 RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, CLEANUP,
0113 RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0114 RECOVERY, OIL SPILLS, CLEANUP, DESIGN-ENGINEERING, *EQUIPMENT EVALUATION,
0115 RECOVERY, OIL SPILLS, CLEANUP, ABSORPTION, *POLYETHYLENE FOAM,
0116 RECOVERY, PETROLEUM PRODUCTS, OIL SPILLS, CRUDE OIL, DESIGN-ENGINEERING, *BILGE WATER RECOVERY,
0118 RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0119 RECOVERY, OIL-WATER SEPARATION, HYDROCARBONS, ABSORPTION, *OLEOPHILIC MATERIAL,
0120 RECOVERY, OIL SPILLS, SKIMMERS, DESIGN-ENGINEERING,
0123 RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, DESIGN-ENGINEERING,
0124 RECOVERY, OIL SPILLS, CLEANUP, *FERROMAGNETIC GRANULES,
0173 RECOVERY, PETROLEUM PRODUCTS, WASTEWATER TREATMENT, CONTAMINANTS,
0216 RECOVERY, RECYCLING, WASTE OIL, FUEL OIL, REFINING, ECONOMICS,
0867 RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, BIBLIOGRAPHIES, CLEANUP, SKIMMERS, ABSORPTION, DISPERSANTS, FLOTATION,
0210 RECYCLING, LEGISLATION, GUIDELINES, WASTE OIL, DISPOSAL, REUSE,
0214 RECYCLING, LUBRICATING OIL, LEGISLATION, WASTE OIL, TREATMENT, FUEL OIL, U.K.,
0215 RECYCLING, RECLAMATION, LUBRICATING OIL, CRANKCASE OIL,
0216 RECYCLING, RECOVERY, WASTE OIL, FUEL OIL, REFINING, ECONOMICS,
0221 RECYCLING, RECLAMATION, WASTE OIL, ENVIRONMENTAL EFFECTS, FRESHWATER, SEAWATER, UK,
0222 RECYCLING, INDIA, REFINING, CRANKCASE OIL, WASTE OIL,
0227 RECYCLING, LUBRICATING OIL, INDIA, REUSE, CRANKCASE OIL,
0231 RECYCLING, PETROCHEMICALS, MANUALS, INDUSTRIES, SOLID WASTES, WASTEWATERS, WASTE OIL,
0031 REFINERIES, OIL DISCHARGES, MEDITERRANEAN SEA, HYDROCARBONS, CONTAMINATION, TANKERS,
0036 REFINERIES, PETROCHEMICALS, MONITORING, VENEZUELA, ENVIRONMENTAL EFFECTS, *BASELINE STUDIES,
0037 REFINERIES, OCEANS, MONITORING, WASHINGTON, *PHYSICAL AND CHEMICAL CHARACTERIZATION, *CHERRY POINT REFINERY,
0038 REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, WASHINGTON, CHERRY POINT REFINERY,
0039 REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, WASHINGTON, *CHERRY POINT REFINERY,
0040 REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES, ENVIRONMENTAL EFFECTS, WASHINGTON, *CHERRY POINT REFINERY,
0068 REFINERIES, HYDROCARBONS, SEAWATER, ANALYTICAL TECHNIQUES, SPECTROSCOPY, CANADA, ENVIRONMENTAL EFFECTS, *COME-BY-CHANCE BAY,
0108 REFINERIES, RECOVERY, OIL SLICKS, SKIMMERS, DESIGN-ENGINEERING,
0127 REFINERIES, PETROCHEMICALS, OIL SPILLS, WASTEWATER TREATMENT, CONSERVATION, AUSTRALIA,
0136 REFINERIES, OIL WELLS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, TANKERS, DESIGN-ENGINEERING,
0140 REFINERIES, INCINERATION, WASTEWATER TREATMENT, SLUDGE, YUGOSLAVIA,
0151 REFINERIES, POLLUTION CONTROL, WASTEWATER TREATMENT, *PURIFICATION,
0155 REFINERIES, POLLUTION CONTROL, WASTEWATERS, BELGIUM,
0156 REFINERIES, PETROCHEMICALS, OXIDATION, WASTEWATER TREATMENT, ECONOMICS,
0175 REFINERIES, PETROLEUM PRODUCTS, WASTEWATER TREATMENT,
0177 REFINERIES, OIL-WATER SEPARATION, WASTEWATER TREATMENT, USSR,
0179 REFINERIES, WASTEWATER TREATMENT, ADSORPTION,
0181 REFINERIES, OIL INDUSTRY, OIL FIELDS, WASTEWATER DISPOSAL, ENVIRONMENTAL EFFECTS,
0196 REFINERIES, PH CONTROL, WASTEWATER TREATMENT, FLOCCULATION, SEDIMENTATION,
0197 REFINERIES, PH CONTROL, OXIDATION, WASTEWATER TREATMENT, FLOCCULATION, FLOTATION,
0198 REFINERIES, PH CONTROL, OXIDATION, OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION,
0199 REFINERIES, POLLUTION CONTROL, WASTEWATER TREATMENT,
0202 REFINERIES, PETROLEUM PRODUCTS, HYDROCARBONS, WASTEWATER TREATMENT,
0203 REFINERIES, OIL-WATER SEPARATION, WASTEWATER TREATMENT,
0253 REFINERIES, POLLUTION CONTROL, ENVIRONMENTAL PROTECTION, CARIBBEAN SEA,
0263 REFINERIES, PETROLEUM PRODUCTS, OIL SPILLS, MONITORING, MARINE ORGANISMS, ACUTE EFFECTS, CHRONIC EFFECTS,
0335 REFINERIES, OIL SPILLS, MODELS, ECONOMICS, BIODEGRADATION, CALIFORNIA, *CRUDE OIL COSTS,
0337 REFINERIES, OIL INDUSTRY, CRUDE OIL, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER TREATMENT, *U.S. EPA,
0338 REFINERIES, OIL INDUSTRY, CRUDE OIL, REGULATIONS, ECONOMIC EFFECTS, WASTEWATER TREATMENT, *U.S. EPA,
0360 REFINERIES, GUIDELINES, ECONOMIC EFFECTS, WASTEWATER TREATMENT, REGULATIONS, *FWPCA,
0386 REFINERIES, OIL US, HYDROCARBONS, BIODEGRADATION, BACTERIA,
0216 REFINING, RECYCLING, RECOVERY, WASTE OIL, FUEL OIL, ECONOMICS,
0217 REFINING, RECLAMATION, WASTE OIL, UK,
0218 REFINING, RECLAMATION, LUBRICATING OIL, WASTE OIL,
0219 REFINING, RECLAMATION, INDIA, CRANKCASE OIL,

0220 REFINING, RECLAMATION, JAPAN, WASTE OIL TREATMENT.
0221 REFINING, RECLAMATION, LUBRICATING OIL, JAPAN, WASTE OIL TREATMENT, SOLVENTS.
0222 REFINING, RECYCLING, INDIA, CRANKCASE OIL, WASTE OIL.
0130 REGULATIONS, OIL SPILLS, DISPERSANTS, TOXICITY, BIBLIOGRAPHIES, CANADA.
0126 REGULATIONS, OIL DISCHARGES, TANKERS, SAFETY.
0129 REGULATIONS, POLLUTION CONTROL, OIL TRANSPORT, OIL DISCHARGES, TANKERS, CONTAMINATION, BALLAST.
0132 REGULATIONS, OIL TRANSFER, OIL SPILLS, TOXICITY, *HAZARDOUS MATERIAL SPILLS.
0201 REGULATIONS, OIL FIELDS, WASTE OIL DISPOSAL, STATE GOVERNMENTS, TEXAS.
0207 REGULATIONS, INDUSTRIES, WATER QUALITY, WASTEWATER TREATMENT, *OIL POLLUTION, *SEWAGE.
0232 REGULATIONS, POLLUTION PREVENTION, LAW ENFORCEMENT, *CIVIL PENALTIES, *U.S. EPA.
0261 REGULATIONS, POLLUTION PREVENTION, OIL SPILLS, OCEANS, CLEANUP, UK.
0250 REGULATIONS, POLLUTION PREVENTION, OIL SPILLS, LIABILITY, TANKERS, SAFETY.
0337 REGULATIONS, REFINERIES, OIL INDUSTRY, CRUDE OIL, ECONOMIC EFFECTS, WASTEWATER TREATMENT, *U.S. EPA.
0338 REGULATIONS, REFINERIES, OIL INDUSTRY, CRUDE OIL, ECONOMIC EFFECTS, WASTEWATER TREATMENT, *U.S. EPA.
0350 REGULATIONS, REFINERIES, GUIDELINES, ECONOMIC EFFECTS, WASTEWATER TREATMENT, *FWPCA.
0361 REGULATIONS, OIL TRANSPORT, OIL SPILLS, OFFSHORE DRILLING, OFFSHORE DEVELOPMENT, EUROPE.
0365 REGULATIONS, PRODUCTION, OFFSHORE DRILLING, OCS, GOVERNMENT AGENCIES, *U.S.G.S.
0422 REGULATIONS, U.S., CRUDE OIL, *RESOURCE ALLOCATIONS, CANADA, FIP, ECONOMIC EFFECTS, *FEA.
0436 REGULATIONS, PRODUCTION, OFFSHORE DRILLING, GUIDELINES, WASTEWATER TREATMENT.
0437 REGULATIONS, POLLUTION CONTROL, OIL DISCHARGES, OFFSHORE PRODUCTION, GUIDELINES, *U.S. EPA
0036 REMOTE SENSING, PETROLEUM PRODUCTS, MONITORING, CONTAMINANTS, WATER QUALITY, *AIR QUALITY.
0044 REMOTE SENSING, POLLUTION CONTROL, OIL SPILLS, ENVIRONMENTAL PROTECTION.
0045 REMOTE SENSING, OIL SPILLS, BALTIC SEA, *MULTISENSOR TECHNIQUE.
0046 REMOTE SENSING, OIL SLICKS, SPREADING, ANALYTICAL TECHNIQUES, *MICROWAVE RADIOMETRY, *IR RADIOMETRY.
0047 REMOTE SENSING, OIL SLICKS, MOVEMENT, MODELS, DELAWARE BAY.
0048 REMOTE SENSING, OIL SLICKS, CONTAINMENT, CLEANUP, *PERFORMANCE TESTS, *MICROWAVE EQUIPMENT.
0049 REMOTE SENSING, OIL SLICKS, MODELS, ESTUARIES, DELAWARE BAY, DRIFT, SPREADING, *FRONTS.
0050 REMOTE SENSING, OIL SPILLS, *OIL FLUORESCENCE CONVERSION EFFICIENCY.
0051 REMOTE SENSING, OIL SLICKS, DETECTION, *INFRARED SENSORS.
0052 REMOTE SENSING, OIL DISCHARGES, MARYLAND, HARBORS, RIVERS, WASTEWATERS, WATER QUALITY.
0053 REMOTE SENSING, OIL SLICKS, OCEANS, EMULSIONS, *THERMAL RADIATION, *FLUID FILMS.
0054 REMOTE SENSING, OIL SPILLS, OIL SLICKS, JAPAN, SEA OF, SPREADING.
0055 REMOTE SENSING, PUERTO RICO, OIL SLICKS, COASTS, SEDIMENTS, CORAL REEFS, VIRGIN ISLANDS, *SKYLAB.
0056 REMOTE SENSING, OIL SPILLS, OIL SLICKS, DETECTION, *RADAR.
0057 REMOTE SENSING, OIL SPILLS, NATURAL SEEPAGE, DETECTION, *FRAUNHOFER LINE DISCRIMINATOR.
0081 REMOTE SENSING, OIL SPILLS, MONITORING, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES.
0226 RESTORATION, PIPELINES, OIL SPILLS, CONTINGENCY PLANNING, ALASKA, CLEANUP.
0254 RESTORATION, OIL SPILLS, ST. LAWRENCE RIVER, GOVERNMENT AGENCIES, U.S., CANADA, CLEANUP, BIRDS.
0095 REUSE, OIL-WATER SEPARATION, OIL TANKS, WASTEWATER TREATMENT, CLEANUP.
0210 REUSE, RECYCLING, LEGISLATION, GUIDELINES, WASTE OIL, DISPOSAL.
0212 REUSE, RECLAMATION, OIL-WATER SEPARATION, WASTEWATERS, WASTE OIL.
0224 REUSE, RECLAMATION, LUBRICATING OIL, WASTE OIL, FUELS.
0225 REUSE, RECYCLING, LUBRICATING OIL, INDIA, CRANKCASE OIL.
0052 RIVERS, REMOTE SENSING, OIL DISCHARGES, MARYLAND, HARBORS, WASTEWATERS, WATER QUALITY.
0125 SAFETY, PETROLEUM PRODUCTS, LEAKAGE, STORAGE, CRUDE OIL, ECONOMICS, *UNDERGROUND SALT CAVERNS.
0126 SAFETY, REGULATIONS, OIL DISCHARGES, TANKERS.
0250 SAFETY, REGULATIONS, POLLUTION PREVENTION, OIL SPILLS, LIABILITY, TANKERS.
0258 SAFETY, OFFSHORE PRODUCTION, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, AUSTRALIA.
0027 SAMPLING, MONITORING, HYDROCARBONS, STORAGE.
0028 SAMPLING, OIL SLICKS, MONITORING, MARINE ORGANISMS, TAR, ANALYTICAL TECHNIQUES, SEDIMENTS, SEAWATER.
0058 SAMPLING, OIL SLICKS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROMETRY.
0059 SAMPLING, MOLLUSKS, HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, ADRIATIC SEA, *MUSSELS, *GULF OF VENICE.
0060 SAMPLING, HYDROCARBONS, DETECTION, SOLUBILITY, SEAWATER.
0071 SAMPLING, OIL SPILLS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, SPECTROMETRY.
0076 SAMPLING, HYDROCARBONS, DETECTION, CHEMICAL ANALYSIS, DESIGN-ENGINEERING.
0078 SAMPLING, HYDROCARBONS, CHEMICAL ANALYSIS, SEAWATER, *SURFACE MICROLAYER.
0080 SAMPLING, OIL SPILLS, ANALYTICAL TECHNIQUES, *FLUORESCENCE, *HYDROGEN EXTRACTION, SOURCE IDENTIFICATION.
0084 SAMPLING, PETROLEUM PRODUCTS, OIL SPILLS, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS.
0323 SAMPLING, LAKES, CHEMICAL ANALYSIS, [illegible] SEDIMENTS, DISTRIBUTION, *DREDGED SPOILS.
0086 SAN FRANCISCO BAY, TAR, HYDROCARBONS, ALGAE, CARCINOGENS, ESTUARIES, FOOD WEB, CALIFORNIA.

0328 SANTA BARBARA CHANNEL, OFFSHORE PRODUCTION, NATURAL SEEPAGE, MEXICO/GULF OF, MARINE ORGANISMS, BIOLOGICAL EFFECTS, VENEZUELA, TAR, BERMUDA COAST,
0369 SANTA BARBARA CHANNEL, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, OCS, S.B, ENVIRONMENTAL EFFECTS, *U.S.G.S.,
0371 SANTA BARBARA CHANNEL, PIPELINES, OIL SPILLS, OFFSHORE PRODUCTION, EIS, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS, TANKERS,
0016 SCOTLAND, OIL SPILLS, FUEL OIL, ENVIRONMENTAL EFFECTS, BIRDS, *SANDS OF FORVIE,
0136 SCOTLAND, OIL TRANSFER, *OIL TERMINAL, ENVIRONMENTAL EFFECTS, *SULLOM VOE,
0250 SCOTLAND, OFFSHORE DEVELOPMENT, BIOLOGICAL EFFECTS, BIRDS, FISHERIES, *CONFERENCE,
0276 SCOTLAND, POLLUTION CONTROL, OIL SPILLS, BIOLOGICAL EFFECTS, FUEL OIL, BIRDS, *RIVER YTHAN,
0365 SCOTLAND, OIL SPILLS, OIL INDUSTRY, ENVIRONMENTAL EFFECTS, PRODUCTION, *SHETLAND ISLANDS, *SULLOM VOE,
0367 SCOTLAND, OIL INDUSTRY, OFFSHORE PRODUCTION, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, COASTS, FISHERIES,
0368 SCOTLAND, OIL INDUSTRY, OCS, ENVIRONMENTAL EFFECTS, SOCIAL EFFECTS, ENVIRONMENTAL CONSERVATION, DEVELOPMENT,
0028 SEAWATER, SAMPLING, OIL SLICKS, MONITORING, MARINE ORGANISMS, TAR, ANALYTICAL TECHNIQUES, SEDIMENTS,
0060 SEAWATER, SAMPLING, HYDROCARBONS, DETECTION, SOLUBILITY,
0066 SEAWATER, REFINERIES, HYDROCARBONS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, CANADA, ENVIRONMENTAL EFFECTS, *COME-BY-CHANCE BAY,
0070 SEAWATER, OIL SPILLS, CALIFORNIA, ANALYTICAL TECHNIQUES, *LUMINESCENCE SIGNATURES, *LOS ANGELES HARBOR,
0076 SEAWATER, SAMPLING, HYDROCARBONS, CHEMICAL ANALYSIS, *SURFACE MICROLAYER,
0153 SEAWATER, HYDROCARBONS, DISPOSAL, *ORGANIC WASTES, WATER QUALITY, CHEMICAL ANALYSIS, SEDIMENTS, FRESHWATER,
0222 SEAWATER, RECYCLING, RECLAMATION, WASTE OIL, ENVIRONMENTAL EFFECTS, FRESHWATER, UK,
0321 SEAWATER, *PARTITIONING STUDIES, *MERCURY, *HCB, CRUDE OIL, SEDIMENTS, FRESHWATER,
0324 SEAWATER, HYDROCARBONS, TOXICITY, BIODEGRADATION, WATER QUALITY, ESTUARIES, FRESHWATER, *U.S. EPA,
0387 SEAWATER, HYDROCARBONS, BIODEGRADATION, ATLANTIC OCEAN, BACTERIA, SEDIMENTS,
0411 SEAWATER, JAPAN, HYDROCARBONS, DECOMPOSITION, *HEXADECANE,
0192 SEDIMENTATION, REFINERIES, PH CONTROL, WASTEWATER TREATMENT, FLOCCULATION,
0340 SEDIMENTATION, OIL SLICKS, HYDROCARBONS, EVAPORATION, ADSORPTION, *SUBTIDAL ENVIRONMENTS,
0353 SEDIMENTATION, OIL SLICKS, HYDROCARBONS, FATE, WEATHERING,
0028 SEDIMENTS, SEAWATER, SAMPLING, OIL SLICKS, MONITORING, MARINE ORGANISMS, TAR, ANALYTICAL TECHNIQUES,
0055 SEDIMENTS, REMOTE SENSING, PUERTO RICO, OIL SLICKS, COASTS, CORAL REEFS, VIRGIN ISLANDS, *SKYLAB,
0067 SEDIMENTS, PAH, MONITORING, MARINE ORGANISMS, CHEMICAL ANALYSIS, *BENZO(A)PYRENE, CHROMATOGRAPHY, *FLUORIMETRY,
0094 SEDIMENTS, CLEANUP, CONTAMINATION, DESIGN-ENGINEERING,
0153 SEDIMENTS, SEAWATER, HYDROCARBONS, DISPOSAL, *ORGANIC WASTES, WATER QUALITY, CHEMICAL ANALYSIS, FRESHWATER,
0262 SEDIMENTS, BIOLOGICAL EFFECTS, CONTAMINATION, *CORALS,
0267 SEDIMENTS, NORTH SEA, MOLLUSKS, HYDROCARBONS, TOXICITY, *OYSTERS,
0301 SEDIMENTS, PAH, HYDROCARBONS, FATE, CRUDE OIL, ALGAE, ESTUARIES, ENGLAND, *DIATOMS,
0321 SEDIMENTS, SEAWATER, *PARTITIONING STUDIES, *MERCURY, *HCB, CRUDE OIL, FRESHWATER,
0323 SEDIMENTS, SAMPLING, LAKES, CHEMICAL ANALYSIS, DISTRIBUTION, *DREDGED SPOILS,
0333 SEDIMENTS, OIL FIELDS, MICROORGANISMS, LOUISIANA, HYDROCARBONS, CHEMICAL EFFECTS, *PETROLEUM DISSOLUTION,
0351 SEDIMENTS, PRUDHOE BAY, MARINE ORGANISMS, HYDROCARBONS, COASTS, ALASKA,
0387 SEDIMENTS, SEAWATER, HYDROCARBONS, BIODEGRADATION, ATLANTIC OCEAN, BACTERIA,
0392 SEDIMENTS, OIL SPILLS, FATE, BEHAVIOR, BEACHES, CANADA, *NOVA SCOTIA,
0396 SEDIMENTS, DISTRIBUTION, CONTAMINANTS, BEACHES, CANADA, *NOVA SCOTIA, *HALIFAX HARBOUR,
0414 SEDIMENTS, MARINE ORGANISMS, FATE, FUEL OIL, CHEDABUCTO BAY, CANADA, BEACHES, *WATER COLUMN, CHRONIC EFFECTS,
0033 SHIPS, MONITORING, DETECTION, *OIL-IN-WATER, DESIGN-ENGINEERING,
0036 SHIPS, MONITORING, DETECTION, *OIL-IN-WATER, *FLAME SPECTROSCOPY,
0145 SHIPS, OIL-WATER SEPARATION, WASTEWATER TREATMENT,
0150 SHIPS, WASTEWATER TREATMENT, WASTEWATER DISPOSAL, WASTE OIL, ENVIRONMENTAL PROTECTION,
0164 SHIPS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, BALLAST, DESIGN-ENGINEERING,
0171 SHIPS, OIL-WATER SEPARATION, BILGES, WASTEWATER TREATMENT,
0190 SHIPS, POLLUTION PREVENTION, OIL DISCHARGES, *TESTING, *OIL CONTENT METERS,
0424 SHIPS, POLLUTION PREVENTION, DESIGN-ENGINEERING, *INTERNATIONAL LAW,
0426 SHIPS, OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, INSURANCE, TANKERS,
0431 SHIPS, POLLUTION PREVENTION, LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INTERNATIONAL AGREEMENTS, ECONOMICS,
0433 SHIPS, POLLUTION PREVENTION, OIL DISCHARGES, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, BALTIC SEA,
0325 SHORELINES, OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, FUEL OIL, BIODEGRADATION, CANADA, CHEDABUCTO BAY,
0019 SKIMMERS, POLLUTION CONTROL, OIL SPILLS, [illegible], CLEANUP, BOOMS, DISPERSANTS,

0096 SKIMMERS, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING,
0097 SKIMMERS, RECOVERY, OIL SPILLS, IRELAND, DESIGN-ENGINEERING, BANTRY BAY,
0101 SKIMMERS, RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, NORWEGIAN SEA, CLEANUP,
0104 SKIMMERS, RECOVERY, OIL SPILLS, CLEANUP, BOOMS, DESIGN-ENGINEERING,
0105 SKIMMERS, REFINERIES, RECOVERY, OIL SLICKS, DESIGN-ENGINEERING,
0107 SKIMMERS, RECOVERY, OIL SPILLS, CLEANUP, DESIGN-ENGINEERING,
0113 SKIMMERS, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING,
0118 SKIMMERS, RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, DESIGN-ENGINEERING,
0120 SKIMMERS, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING,
0160 SKIMMERS, OIL-WATER SEPARATION, OIL SPILLS, DESIGN-ENGINEERING,
0179 SKIMMERS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, ECONOMICS,
0299 SKIMMERS, OIL SPILLS, BLOWOUT PREVENTION, DRILLING, CLEANUP, BEAUFORT SEA, BOOMS,
CONTINGENCY PLANNING,
0255 SKIMMERS, POLLUTION PREVENTION, OIL SPILLS, MONITORING, CONTINGENCY PLANNING, BOOMS,
0387 SKIMMERS, RECOVERY, OIL-WATER SEPARATION, OIL SPILLS, BIBLIOGRAPHIES, CLEANUP,
ADSORPTION, DISPERSANTS, FLOTATION,
0155 SLUDGE, REFINERIES, INCINERATION, WASTEWATER TREATMENT, YUGOSLAVIA,
0161 SLUDGE, OXIDATION, OIL-WATER SEPARATION, WASTEWATER TREATMENT, COAGULATION,
0156 SLUDGE, GUIDELINES, TANKERS, DISPOSAL, CRUDE OIL,
0332 SOCIAL EFFECTS, OIL SPILLS, ENVIRONMENTAL MANAGEMENT,
0368 SOCIAL EFFECTS, SCOTLAND, OIL INDUSTRY, OCS, ENVIRONMENTAL EFFECTS, ENVIRONMENTAL
CONSERVATION, DEVELOPMENT,
0002 SOCIO-ECONOMIC EFFECTS, OFFSHORE DRILLING, OCS, ATLANTIC COAST, ENVIRONMENTAL EFFECTS,
0152 SOCIO-ECONOMIC EFFECTS, POLLUTION PREVENTION, PETROCHEMICALS, LEGISLATION, INDUSTRIES,
WASTEWATER TREATMENT, ECONOMICS,
0327 SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS,
ENVIRONMENTAL MANAGEMENT, BIBLIOGRAPHIES,
0352 SOCIO-ECONOMIC EFFECTS, OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, COASTS, ENVIRONMENTAL
PROTECTION,
0360 SOCIO-ECONOMIC EFFECTS, TAR SANDS, DEVELOPMENT, CANADA, ENVIRONMENTAL EFFECTS,
0361 SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, GUIDELINES, ENVIRONMENTAL EFFECTS,
COASTS, FLORIDA, *ONSHORE EFFECTS,
0363 SOCIO-ECONOMIC EFFECTS, OFFSHORE DEVELOPMENT, OCS, ATLANTIC COAST, *ONSHORE IMPACTS,
ENVIRONMENTAL EFFECTS,
0371 SOCIO-ECONOMIC EFFECTS, SANTA BARBARA CHANNEL, PIPELINES, OIL SPILLS, OFFSHORE
PRODUCTION, EIS, ENVIRONMENTAL EFFECTS, TANKERS,
0117 SOIL, CLEANUP, CONTAMINATION, *DETERGENTS,
0381 SOIL, PAH, MICROORGANISMS, BIODEGRADATION, AROMATIC HYDROCARBONS, *WATERS,
0386 SOIL, METABOLISM, BIODEGRADATION, BACTERIA, FUEL OIL, CRANKCASE OIL, CRUDE OIL,
0060 SOLUBILITY, SEAWATER, SAMPLING, HYDROCARBONS, DETECTION,
0071 SOLUBILITY, AROMATIC HYDROCARBONS, ANALYTICAL TECHNIQUES, *POLYTHERMIC METHOD,
0221 SOLVENTS, REFINING, RECLAMATION, LUBRICATING OIL, JAPAN, WASTE OIL TREATMENT,
0006 SOURCE IDENTIFICATION, OIL SLICKS, ESTUARIES, UK, BIRDS, PILOTS,
0009 SOURCE IDENTIFICATION, OIL SPILLS, TANKERS, FLORIDA, *U.S. COAST GUARD,
0032 SOURCE IDENTIFICATION, OIL SPILLS, MONITORING, ANALYTICAL TECHNIQUES, *LUMINESCENCE
METHODS,
0065 SOURCE IDENTIFICATION, OIL SPILLS, *SPECTRAL SIGNATURES,
0072 SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, *SOLVENT COMPENSATION,
0075 SOURCE IDENTIFICATION, CRUDE OIL, ANALYTICAL TECHNIQUES, SPECTROSCOPY, CHROMATOGRAPHY,
*LUMINESCENCE,
0080 SOURCE IDENTIFICATION, SAMPLING, OIL SPILLS, ANALYTICAL TECHNIQUES, *FLUORESCENCE,
*HYDROGEN EXTRACTION,
0081 SOURCE IDENTIFICATION, REMOTE SENSING, OIL SPILLS, MONITORING, ANALYTICAL TECHNIQUES,
0082 SOURCE IDENTIFICATION, OIL SPILLS, LUBRICATING OIL, ANALYTICAL TECHNIQUES,
*LUMINESCENCE, CRUDE OIL,
0083 SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, *PHOSPHORESCENCE,
0084 SOURCE IDENTIFICATION, SAMPLING, PETROLEUM PRODUCTS, OIL SPILLS, CHEMICAL ANALYSIS,
0085 SOURCE IDENTIFICATION, OIL SPILLS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, STATISTICAL
ANALYSIS,
0086 SOURCE IDENTIFICATION, CONTAMINANTS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, FUEL OIL,
GASOLINE, *FLUORESCENCE,
0087 SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, *FLUORESCENCE SPECTRA,
0413 SOURCE IDENTIFICATION, PLANTS, PAH, OIL SPILLS, OCEANS, HYDROCARBONS, FATE,
0020 SPAIN, OIL SPILLS, MARINE ORGANISMS, TANKERS, CLEANUP, DISPERSANTS, ACUTE EFFECTS,
*URQUIOLA OIL SPILL,
0103 SPAIN, RECOVERY, OIL SPILLS, TANKERS, DESIGN-ENGINEERING, *URQUIOLA OIL SPILL,
0056 SPECTROMETRY, SAMPLING, OIL SLICKS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY,
0073 SPECTROMETRY, SAMPLING, OIL SPILLS, CHEMICAL ANALYSIS, CHROMATOGRAPHY,
0389 SPECTROMETRY, HYDROCARBONS, BIODEGRADATION, CRUDE OIL, ANALYTICAL TECHNIQUES,
0036 SPECTROSCOPY, SHIPS, MONITORING, DETECTION, *OIL-IN-WATER, *FLAME
0052 SPECTROSCOPY, NORTH CAROLINA, MICROORGANISMS, HYDROCARBONS, ANALYTICAL TECHNIQUES,
ESTUARIES,
0068 SPECTROSCOPY, SEAWATER, REFINERIES, HYDROCARBONS, ANALYTICAL TECHNIQUES, CANADA,
ENVIRONMENTAL EFFECTS, *COME-BY-CHANCE BAY,
0075 SPECTROSCOPY, SOURCE IDENTIFICATION, CRUDE OIL, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY,

*LUMINESCENCE,
0188 SPECTROSCOPY, LUBRICATING OIL, WASTEWATER TREATMENT, BILGES, EMULSIONS, ANALYTICAL TECHNIQUES, FUEL OIL,
0080 SPREADING, REMOTE SENSING, OIL SLICKS, ANALYTICAL TECHNIQUES, MICROWAVE RADIOMETRY, S/P RADIOMETRY,
0088 SPREADING, REMOTE SENSING, OIL SLICKS, MODELS, ESTUARIES, DELAWARE BAY, DRIFT, *FRONTS,
0088 SPREADING, REMOTE SENSING, OIL SPILLS, OIL SLICKS, JAPAN/SEA OF,
0161 SPREADING, OIL SLICKS, BEHAVIOR, WEATHERING, EVAPORATION, TAR,
0261 ST. LAWRENCE RIVER, POLLUTION CONTROL, PERSONNEL TRAINING, OIL SPILLS, CONTINGENCY PLANNING, CLEANUP, *FIELD TESTS,
0266 ST. LAWRENCE RIVER, RESTORATION, OIL SPILLS, GOVERNMENT AGENCIES, U.S., CANADA, CLEANUP, BIRDS,
0012 ST. LAWRENCE RIVER, OIL SLICKS, MOVEMENT, MODELS, CANADA,
0201 STATE GOVERNMENTS, REGULATIONS, OIL FIELDS, WASTE OIL DISPOSAL, TEXAS,
0417 STATE GOVERNMENTS, PORTS, OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION, ENVIRONMENTAL PROTECTION,
0418 STATE GOVERNMENTS, OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION, U.S. GOVERNMENT,
0085 STATISTICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, CHEMICAL ANALYSIS, CHROMATOGRAPHY,
0314 STATISTICS, POLLUTION CONTROL, OIL TRANSPORT, STORAGE, PRODUCTION,
0027 STORAGE, SAMPLING, MONITORING, HYDROCARBONS,
0096 STORAGE, PETROLEUM PRODUCTS, CONTAINMENT, FUELS, ARCTIC, *SPILL CONTAINMENT DIKES,
0121 STORAGE, OIL TANKS, CLEANUP, CONTAMINATION, *RESIDUAL OIL, *EMULSIFICATION,
0124 STORAGE, SAFETY, PETROLEUM PRODUCTS, LEAKAGE, CRUDE OIL, ECONOMICS, *UNDERGROUND SALT CAVERNS,
0127 STORAGE, PORTS, OIL TRANSPORT, U.S., TANKERS, ECONOMICS, ENVIRONMENTAL EFFECTS,
0131 STORAGE, POLLUTION PREVENTION, OIL TANKS, *ACOUSTIC EMISSION METHODS,
0136 STORAGE, CRUDE OIL, ENVIRONMENTAL EFFECTS, EIS, *FEA, *SALT DOMES,
0137 STORAGE, CRUDE OIL, ENVIRONMENTAL EFFECTS, *FEA, *SALT DOMES,
0237 STORAGE, POLLUTION PREVENTION, OIL SPILLS, LEGISLATION, DISCHARGES, CONTINGENCY PLANNING, *FWPCA,
0314 STORAGE, STATISTICS, POLLUTION CONTROL, OIL TRANSPORT, PRODUCTION,
0423 STORAGE, OIL TANKS, LEGISLATION, U.S., CRUDE OIL, EIS, ENVIRONMENTAL EFFECTS,
0110 SURFACTANTS, OIL SPILLS, CLEANUP, DISPERSANTS,
0111 SURFACTANTS, OIL SPILLS, CLEANUP, DISPERSANTS,
0235 SWEDEN, POLLUTION PREVENTION, OIL SPILLS,
0021 TANKERS, OIL SPILLS, METULA OIL SPILL, MAGELLAN/STRAIT OF, BEACHES,
0004 TANKERS, OIL SPILLS, *SUPERTANKER ACCIDENTS,
0009 TANKERS, SOURCE IDENTIFICATION, OIL SPILLS, FLORIDA, *U.S. COAST GUARD,
0012 TANKERS, REFINERIES, OIL DISCHARGES, MEDITERRANEAN SEA, HYDROCARBONS, CONTAMINATION,
0020 TANKERS, SPAIN, OIL SPILLS, MARINE ORGANISMS, CLEANUP, DISPERSANTS, ACUTE EFFECTS, *URQUIOLA OIL SPILL,
0102 TANKERS, SPAIN, RECOVERY, OIL SPILLS, DESIGN-ENGINEERING, *URQUIOLA OIL SPILL,
0126 TANKERS, SAFETY, REGULATIONS, OIL DISCHARGES,
0127 TANKERS, STORAGE, PORTS, OIL TRANSPORT, U.S., ECONOMICS, ENVIRONMENTAL EFFECTS,
0129 TANKERS, REGULATIONS, POLLUTION CONTROL, OIL TRANSPORT, OIL DISCHARGES, CONTAMINATION, BALLAST,
0133 TANKERS, OIL SPILLS, LIABILITY, LEGISLATION, INTERNATIONAL CONVENTIONS, INSURANCE, DESIGN-ENGINEERING,
0135 TANKERS, OIL-WATER SEPARATION, JAPAN, WASTEWATER TREATMENT, BILGES,
0142 TANKERS, REFINERIES, OIL WELLS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, DESIGN-ENGINEERING,
0168 TANKERS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,
0170 TANKERS, WASTEWATER TREATMENT, WASTE OIL TREATMENT, BALLAST, BIODEGRADATION,
0185 TANKERS, SLUDGE, GUIDELINES, DISPOSAL, CRUDE OIL,
0200 TANKERS, BILGES, WASTEWATER TREATMENT, *CHARACTERIZATION STUDIES, FUELS,
0279 TANKERS, POLLUTION PREVENTION, OIL SPILLS, CONTINGENCY PLANNING, CLEANUP, GOVERNMENT AGENCIES, *U.S.C.G.,
0250 TANKERS, SAFETY, REGULATIONS, POLLUTION PREVENTION, OIL SPILLS, LIABILITY,
0310 TANKERS, OIL SPILLS, JAPAN, CRUDE OIL, BEACHES, *NIIGATA COAST,
0320 TANKERS, OIL SPILLS, ENVIRONMENTAL DETERIORATION,
0322 TANKERS, POLLUTION CONTROL, OIL SPILLS, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL EFFECTS, CLEANUP, CONTINGENCY PLANNING,
0350 TANKERS, OIL SPILLS, OIL INDUSTRY, OFFSHORE PRODUCTION, ENVIRONMENTAL PROTECTION, OREGON,
0370 TANKERS, PIPELINES, OIL TRANSPORT, OIL TRANSFER, ENVIRONMENTAL EFFECTS,
0371 TANKERS, SOCIO-ECONOMIC EFFECTS, SANTA BARBARA CHANNEL, PIPELINES, OIL SPILLS, OFFSHORE PRODUCTION, EIS, ENVIRONMENTAL EFFECTS,
0428 TANKERS, SHIPS, OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, INSURANCE,
0441 TANKERS, PORTS, BIBLIOGRAPHIES, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS,
0444 TANKERS, PORTS, BIBLIOGRAPHIES, ENVIRONMENTAL EFFECTS, *SUPERTANKERS, *DEEPWATER PORTS,
0026 TAR, OCEANS, MONITORING, DETECTION, DISTRIBUTION,
0028 TAR, SEDIMENTS, SEAWATER, SAMPLING, OIL SLICKS, MONITORING, MARINE ORGANISMS, ANALYTICAL TECHNIQUES,
0042 TAR, PACIFIC OCEAN, OCEANS, MONITORING, DISTRIBUTION,

0328 TAR, SANTA BARBARA CHANNEL, OFFSHORE PRODUCTION, NATURAL SEEPAGE, MEXICO/GULF OF,
MARINE ORGANISMS, BIOLOGICAL EFFECTS, VENEZUELA, BERMUDA COAST,
[illegible] TAR, SPREADING, OIL SLICKS, BEHAVIOR, WEATHERING, EVAPORATION,
[illegible] TAR SANDS, PRODUCTION, CONTAMINATION, WATER QUALITY, CANADA, ATHABASCA OIL SANDS,
[illegible] TAR SANDS, PRODUCTION, EXTRACTION, ENVIRONMENTAL EFFECTS, WASTEWATER DISPOSAL,
[illegible] TAR SANDS, SOCIO-ECONOMIC EFFECTS, DEVELOPMENT, CANADA, ENVIRONMENTAL EFFECTS,
[illegible] TEXAS, STATE GOVERNMENT, REGULATION, OIL FIELDS, WASTE OIL DISPOSAL,
[illegible] TOXICITY, REGULATIONS, OIL SPILLS, DISPERSANTS, BIBLIOGRAPHIES, CANADA,
[illegible] TOXICITY, REGULATIONS, OIL TRANSPORT, OIL SPILLS, HAZARDOUS MATERIAL SPILLS,
[illegible] TOXICITY, MOLLUSKS, BIOLOGICAL EFFECTS, DISPERSANTS, CRUDE OIL, RESPIRATION RATE,
[illegible] TOXICITY, HYDROCARBONS, CRUDE OIL, FISHES, CRUSTACEANS, CHEMICAL ANALYSIS,
[illegible] TOXICITY, SEDIMENTS, NORTH SEA, MOLLUSKS, HYDROCARBONS, BIOTA,
[illegible] TOXICITY, METABOLISM, HYDROCARBONS, BIOLOGICAL EFFECTS, ZOOPLANKTON,
[illegible] TOXICITY, METABOLISM, ACUTE EFFECTS, CHRONIC EFFECTS, CRUDE OIL, FUEL OIL,
CRUSTACEANS, SHORE CRAB,
0280 TOXICITY, OIL SPILLS, MARINE ORGANISMS, DISPERSANTS, ACUTE EFFECTS, CHRONIC EFFECTS,
[illegible] TOXICITY, METABOLISM, MARINE ORGANISMS, CONTAMINANTS,
[illegible] TOXICITY, FUELS, FISHES, FRESHWATER, JET ENGINE FUELS,
[illegible] TOXICITY, BIOLOGICAL EFFECTS, CRUDE OIL, EMULSIFIERS, FISHES,
[illegible] TOXICITY, METABOLISM, MARINE ORGANISMS, INVERTEBRATES, CRUDE OIL, ARCTIC,
[illegible] TOXICITY, HYDROCARBONS, CRUSTACEANS, ESTUARINE GRASS SHRIMP, PALAEMONETES PUGIO,
[illegible] TOXICITY, MONITORING, BIOLOGICAL EFFECTS, CRUDE OIL, CRUSTACEANS, AMERICAN LOBSTER,
[illegible] TOXICITY, METABOLISM, HYDROCARBONS, BIOLOGICAL EFFECTS, FISHES,
[illegible] TOXICITY, SEAWATER, HYDROCARBONS, BIODEGRADATION, WATER QUALITY, ESTUARIES,
FRESHWATER, U.S. EPA,
[illegible] TOXICITY, OFFSHORE PRODUCTION, BIOLOGICAL EFFECTS, FISHERIES, CRUDE OIL, LOUISIANA,
[illegible] TOXICITY, PLANTS, FORMATION FLUIDS, DRILLING, LAND ANIMALS,
[illegible] TOXICITY, OIL SPILLS, MARINE ORGANISMS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS,
ENVIRONMENTAL EFFECTS,
0008 UK, SOURCE IDENTIFICATION, OIL SLICKS, ESTUARIES, BIRDS, FISHES,
0010 UK, OIL SPILLS, CRUDE OIL, *FINES,
0022 UK, OIL SPILLS, CRUDE OIL, CLEANUP, *DOVER STRAIT,
0217 UK, REFINING, RECLAMATION, WASTE OIL,
0222 UK, SEAWATER, RECYCLING, RECLAMATION, WASTE OIL, ENVIRONMENTAL EFFECTS, FRESHWATER,
0227 UK, PERSONNEL TRAINING, OIL SPILLS, CLEANUP, *POLLUTION CLEANUP FILM,
0241 UK, REGULATIONS, POLLUTION PREVENTION, OIL SPILLS, OCEANS, CLEANUP,
0006 U.S., OIL SPILLS, INLAND, CRUDE OIL, FUEL OIL, CANADA,
0127 U.S., TANKERS, STORAGE, PORTS, OIL TRANSPORT, ECONOMICS, ENVIRONMENTAL EFFECTS,
0216 U.S., RECYCLING, LUBRICATING OIL, LEGISLATION, WASTE OIL TREATMENT, FUEL OIL,
0245 U.S., POLLUTION PREVENTION, POLLUTION CONTROL, OIL SPILLS, OIL DISCHARGES,
LEGISLATION, CANADA, CONTINGENCY PLANNING,
0254 U.S., ST. LAWRENCE RIVER, RESTORATION, OIL SPILLS, GOVERNMENT AGENCIES, CANADA,
CLEANUP, BIRDS,
0356 U.S., OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, LIABILITY, LEGISLATION, DELAWARE,
ENVIRONMENTAL PROTECTION,
0419 U.S., OIL SPILLS, LIABILITY, LEGISLATION, *COMPENSATION,
0420 U.S., OIL DISCHARGES, LEGISLATION, LAW ENFORCEMENT, *FWPCA,
0421 U.S., OIL SPILLS, LIABILITY, LEGISLATION, *PRIVATE DAMAGE SUITS,
0422 U.S., REGULATIONS, CRUDE OIL, *RESOURCE ALLOCATIONS, CANADA, EIS, ECONOMIC EFFECTS,
*EPA,
0423 U.S., STORAGE, OIL TANKS, LEGISLATION, CRUDE OIL, EIS, ENVIRONMENTAL EFFECTS,
0346 U.S. GOVERNMENT, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, ALASKA,
0418 U.S. GOVERNMENT, STATE GOVERNMENTS, OFFSHORE DEVELOPMENT, NORTH CAROLINA, LEGISLATION,
0015 USSR, SKIMMERS, POLLUTION CONTROL, OIL SPILLS, CLEANUP, BOOMS, DISPERSANTS,
0177 USSR, REFINERIES, OIL-WATER SEPARATION, WASTEWATER TREATMENT,
0025 VENEZUELA, REFINERIES, PETROCHEMICALS, MONITORING, ENVIRONMENTAL EFFECTS, *BASELINE
STUDIES,
0264 VENEZUELA, LAKES, BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, *LAKE MARACAIBO,
0265 VENEZUELA, OIL DISCHARGES, LAKES, WASTEWATERS, BIOLOGICAL EFFECTS, FATE, FISHERIES,
ECONOMICS, *LAKE MARACAIBO,
0297 VENEZUELA, LAKES, BIOLOGICAL EFFECTS, *OIL COLLECTING AGENTS, *LAKE MARACAIBO,
0298 VENEZUELA, OIL DISCHARGES, LAKES, WASTEWATERS, BIOLOGICAL EFFECTS, FISHERIES,
ECONOMICS, *LAKE MARACAIBO,
0328 VENEZUELA, TAR, SANTA BARBARA CHANNEL, OFFSHORE PRODUCTION, NATURAL SEEPAGE,
MEXICO/GULF OF, MARINE ORGANISMS, BIOLOGICAL EFFECTS, BERMUDA COAST,
0055 VIRGIN ISLANDS, SEDIMENTS, REMOTE SENSING, PUERTO RICO, OIL SLICKS, COASTS, CORAL
REEFS, *SKYLAB,
0037 WASHINGTON, REFINERIES, OCEANS, MONITORING, *PHYSICAL AND CHEMICAL CHARACTERIZATION,
*CHERRY POINT REFINERY,
0038 WASHINGTON, REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES,
ENVIRONMENTAL EFFECTS, *CHERRY POINT REFINERY,
0039 WASHINGTON, REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES,
ENVIRONMENTAL EFFECTS, *CHERRY POINT REFINERY,
0040 WASHINGTON, REFINERIES, OIL SPILLS, OIL DISCHARGES, MONITORING, *BASELINE STUDIES,
ENVIRONMENTAL EFFECTS, *CHERRY POINT REFINERY,

[illegible] WASHINGTON, RECOVERY, PUGET SOUND, OIL SPILLS, OIL INDUSTRY, *SPILL RECOVERY VESSEL,
[illegible] WASTE OIL, NEW YORK, CONTAMINATION, *SEWAGE, BEACHES,
0150 WASTE OIL, SHIPS, WASTEWATER TREATMENT, WASTEWATER DISPOSAL, ENVIRONMENTAL PROTECTION,
[illegible] WASTE OIL, OIL-WATER SEPARATION, BILGES, DESIGN-ENGINEERING,
[illegible] WASTE OIL, REUSE, RECYCLING, EVALUATION, GUIDELINES, DISPOSAL,
[illegible] WASTE OIL, RECLAMATION, DESIGN-ENGINEERING,
0212 WASTE OIL, REUSE, RECLAMATION, OIL-WATER SEPARATION, WASTEWATERS,
[illegible] WASTE OIL, RECLAMATION, LUBRICATING OIL, FUEL OIL, *CRANKCASE OIL,
[illegible] WASTE OIL, REFINING, RECYCLING, RECOVERY, FUEL OIL, ECONOMICS,
[illegible] WASTE OIL, REFINING, RECLAMATION,
[illegible] WASTE OIL, REFINING, RECLAMATION, LUBRICATING OIL,
[illegible] WASTE OIL, STANDARDS, RECYCLING, RECLAMATION, ENVIRONMENTAL EFFECTS, FRESHWATER,
[illegible] WASTE OIL, REFINING, RECYCLING, INDIA, *CRANKCASE OIL,
[illegible] WASTE OIL, REUSE, RECLAMATION, LUBRICATING OIL, FUELS,
0226 WASTE OIL, RECYCLING, PETROCHEMICALS, MANUALS, INDUSTRIES, SOLID WASTES, WASTEWATERS,
[illegible] WASTE OIL, DISPOSAL, TEXAS, STATE GOVERNMENTS, REGULATIONS, OIL FIELDS,
[illegible] WASTE OIL, TREATMENT, OIL-WATER SEPARATION, EMULSIONS, DESIGN-ENGINEERING,
0154 WASTE OIL, TREATMENT, OIL-WATER SEPARATION, WASTEWATER TREATMENT,
[illegible] WASTE OIL, TREATMENT, INCINERATION, FUEL OIL, *SOLID WASTES, *SEWAGE, DISPOSAL,
[illegible] WASTE OIL, TREATMENT, RECLAMATION, LUBRICATING OIL, DISPOSAL, ENVIRONMENTAL EFFECTS,
[illegible] WASTE OIL, TREATMENT, TANKERS, WASTEWATER TREATMENT, BALLAST, BIODEGRADATION,
[illegible] WASTE OIL, TREATMENT, POLLUTION CONTROL, WASTEWATER TREATMENT,
[illegible] WASTE OIL, TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
[illegible] WASTE OIL, TREATMENT, [illegible], RECYCLING, LUBRICATING OIL, LEGISLATION, FUEL OIL,
0220 WASTE OIL, TREATMENT, REFINING, RECLAMATION, JAPAN,
0221 WASTE OIL, TREATMENT, SOLVENTS, REFINING, RECLAMATION, LUBRICATING OIL, JAPAN,
0012 WASTEWATERS, RIVERS, REMOTE SENSING, OIL DISCHARGES, MARYLAND, HARBORS, WATER QUALITY,
0136 WASTEWATERS, OIL SPILLS, OIL DISCHARGES, OCEANS, INTERNATIONAL CONVENTIONS,
ENVIRONMENTAL PROTECTION, *IMCO,
0155 WASTEWATERS, REFINERIES, POLLUTION CONTROL, BELGIUM,
0212 WASTEWATERS, WASTE OIL, REUSE, RECLAMATION, OIL-WATER SEPARATION,
0226 WASTEWATERS, WASTE OIL, RECYCLING, PETROCHEMICALS, MANUALS, INDUSTRIES, SOLID WASTES,
[illegible] WASTEWATERS, VENEZUELA, OIL DISCHARGES, LAKES, BIOLOGICAL EFFECTS, RATS, FISHERIES,
ECONOMICS, *LAKE MARACAIBO,
0258 WASTEWATERS, VENEZUELA, OIL DISCHARGES, LAKES, BIOLOGICAL EFFECTS, FISHERIES,
ECONOMICS, *LAKE MARACAIBO,
0272 WASTEWATERS, HYDROCARBONS, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, *1,3-BUTADIENE,
0362 WASTEWATERS, POLLUTION CONTROL, OIL SHALE DEVELOPMENT, ENVIRONMENTAL PROTECTION,
GOVERNMENT AGENCIES, *U.S. EPA,
0146 WASTEWATER DISPOSAL, OIL-WATER SEPARATION, WASTEWATER TREATMENT, COALESCENCE, BILGES,
BALLAST,
0150 WASTEWATER DISPOSAL, WASTE OIL, SHIPS, WASTEWATER TREATMENT, ENVIRONMENTAL PROTECTION,
0191 WASTEWATER DISPOSAL, REFINERIES, OIL INDUSTRY, OIL FIELDS, ENVIRONMENTAL EFFECTS,
0365 WASTEWATER DISPOSAL, TAR SANDS, PRODUCTION, EXTRACTION, ENVIRONMENTAL EFFECTS,
0095 WASTEWATER TREATMENT, REUSE, OIL-WATER SEPARATION, OIL TANKS, CLEANUP,
0135 WASTEWATER TREATMENT, TANKERS, OIL-WATER SEPARATION, JAPAN, BILGES,
0139 WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING, *FLOATABLE BARGES,
0140 WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, FILTRATION, *ULTRAFILTRATION,
0142 WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN-ENGINEERING,
0143 WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE, DESIGN-ENGINEERING,
0144 WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
0145 WASTEWATER TREATMENT, SHIPS, OIL-WATER SEPARATION,
0146 WASTEWATER TREATMENT, WASTEWATER DISPOSAL, OIL-WATER SEPARATION, COALESCENCE, BILGES,
BALLAST,
0147 WASTEWATER TREATMENT, REFINERIES, PETROCHEMICALS, OIL SPILLS, CONSERVATION, AUSTRALIA,
0148 WASTEWATER TREATMENT, TANKERS, REFINERIES, OIL WELLS, OIL-WATER SEPARATION,
DESIGN-ENGINEERING,
0149 WASTEWATER TREATMENT, SLUDGE, REFINERIES, INCINERATION, YUGOSLAVIA,
0150 WASTEWATER TREATMENT, WASTEWATER DISPOSAL, WASTE OIL, SHIPS, ENVIRONMENTAL PROTECTION,
0151 WASTEWATER TREATMENT, REFINERIES, POLLUTION CONTROL, *PURIFICATION,
0152 WASTEWATER TREATMENT, SOCIO-ECONOMIC EFFECTS, POLLUTION PREVENTION, PETROCHEMICALS,
LEGISLATION, INDUSTRIES, ECONOMICS,
0154 WASTEWATER TREATMENT, WASTE OIL TREATMENT, OIL-WATER SEPARATION,
0156 WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, *CATIONIC POLYMERS,
0157 WASTEWATER TREATMENT, OIL-WATER SEPARATION, DETECTION, CONTAMINATION,
DESIGN-ENGINEERING,
0158 WASTEWATER TREATMENT, REFINERIES, PETROCHEMICALS, OXIDATION, ECONOMICS,
0159 WASTEWATER TREATMENT, OIL-WATER SEPARATION, HYDROCARBONS, *SOLVENT EXTRACTION,
0163 WASTEWATER TREATMENT, PETROCHEMICALS, OXIDATION, OIL-WATER SEPARATION, OIL INDUSTRY,
INCINERATION, FLOTATION, FILTRATION, ADSORPTION,
0164 WASTEWATER TREATMENT, SHIPS, OIL-WATER SEPARATION, BALLAST, DESIGN-ENGINEERING,
0165 WASTEWATER TREATMENT, SLUDGE, OXIDATION, OIL-WATER SEPARATION, COAGULATION,
0166 WASTEWATER TREATMENT, PH CONTROL, OIL-WATER SEPARATION, EMULSIONS,
0167 WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, *ULTRAFILTRATION MEMBRANES,
0168 WASTEWATER TREATMEN., TANKERS, OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION,

[illegible] WASTEWATER TREATMENT; INDUSTRIES, CONTAMINANTS, FLOCCULATION, POLYELECTROLYTES,
[illegible] WASTEWATER TREATMENT; WASTE OIL TREATMENT, TANKERS, BALLAST, BIODEGRADATION,
[illegible] WASTEWATER TREATMENT; SHIPS, OIL-WATER SEPARATION, BILGES,
[illegible] WASTEWATER TREATMENT; WASTE OIL TREATMENT, POLLUTION CONTROL,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS, DESIGN-ENGINEERING,
[illegible] WASTEWATER TREATMENT; REFINERIES, OIL-WATER SEPARATION, EMULSIONS, ECONOMICS,
[illegible] WASTEWATER TREATMENT; REFINERIES, PETROLEUM PRODUCTS,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS,
[illegible] WASTEWATER TREATMENT; USSR, REFINERIES, OIL-WATER SEPARATION,
[illegible] WASTEWATER TREATMENT; REFINERIES, ADSORPTION,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, DISPERSIONS, COALESCENCE, SULFUR,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, ADSORPTION,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION, ADSORPTION,
[illegible] WASTEWATER TREATMENT; RECOVERY, PETROLEUM PRODUCTS, CONTAMINANTS,
[illegible] WASTEWATER TREATMENT; PETROLEUM PRODUCTS, OXIDATION, FILTRATION,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, COALESCENCE, *OIL WETTABILITY,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, COALESCENCE, EMULSIONS, DESIGN-ENGINEERING,
[illegible] WASTEWATER TREATMENT; SPECTROSCOPY, LUBRICATING OIL, BILGES, EMULSIONS, ANALYTICAL
TECHNIQUES, FUEL OIL,
[illegible] WASTEWATER TREATMENT; SEDIMENTATION, REFINERIES, PH CONTROL, FLOCCULATION,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, INCINERATION, EMULSIONS, FILTRATION, FUEL
OIL,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, DESIGN-ENGINEERING, *COANDA EFFECT,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, LUBRICATING OIL, EMULSIONS, FLOCCULATION,
FILTRATION,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS, FILTRATION,
[illegible] WASTEWATER TREATMENT; REFINERIES, PH CONTROL, OXIDATION, FLOCCULATION, FLOTATION,
[illegible] WASTEWATER TREATMENT; REFINERIES, PH CONTROL, OXIDATION, OIL-WATER SEPARATION,
FLOCCULATION,
0199 WASTEWATER TREATMENT; REFINERIES, POLLUTION CONTROL,
[illegible] WASTEWATER TREATMENT; TANKERS, BILGES, *CHARACTERIZATION STUDIES, FUELS,
[illegible] WASTEWATER TREATMENT; REFINERIES, PETROLEUM PRODUCTS, HYDROCARBONS,
[illegible] WASTEWATER TREATMENT; REFINERIES, OIL-WATER SEPARATION,
0206 WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS, COAGULATION, FLOCCULATION,
FILTRATION,
0208 WASTEWATER TREATMENT; PH CONTROL, OIL-WATER SEPARATION, FILTRATION,
[illegible] WASTEWATER TREATMENT; REGULATIONS, INDUSTRIES, WATER QUALITY, *OIL POLLUTION, *SEWAGE,
[illegible] WASTEWATER TREATMENT; OIL-WATER SEPARATION, EMULSIONS, COAGULATION,
0336 WASTEWATER TREATMENT; OFFSHORE PRODUCTION, MEXICO GULF OF, GUIDELINES, ECONOMIC
EFFECTS, ALASKA, CALIFORNIA,
0337 WASTEWATER TREATMENT; REGULATIONS, REFINERIES, OIL INDUSTRY, CRUDE OIL, ECONOMIC
EFFECTS, *U.S. EPA,
0338 WASTEWATER TREATMENT; REGULATIONS, REFINERIES, OIL INDUSTRY, CRUDE OIL, ECONOMIC
EFFECTS, *U.S. EPA,
0362 WASTEWATER TREATMENT; REGULATIONS, REFINERIES, GUIDELINES, ECONOMIC EFFECTS, *EWPCA,
0374 WASTEWATER TREATMENT; RECLAMATION, PETROLEUM PRODUCTS, OIL TANKS, OIL SPILLS,
BIODEGRADATION, CLEANUP, BALLAST, BILGES,
0626 WASTEWATER TREATMENT; REGULATIONS, PRODUCTION, OFFSHORE DRILLING, GUIDELINES,
0636 WASTEWATER TREATMENT; PETROCHEMICALS, INDUSTRIES, BIBLIOGRAPHIES, ECONOMICS,
*INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0648 WASTEWATER TREATMENT; PETROCHEMICALS, INDUSTRIES, BIBLIOGRAPHIES, ECONOMICS,
*INDUSTRIAL WASTES, *POLLUTION EFFECTS,
0036 WATER QUALITY; REMOTE SENSING, PETROLEUM PRODUCTS, MONITORING, CONTAMINANTS, *AIR
QUALITY,
0052 WATER QUALITY; WASTEWATERS, RIVERS, REMOTE SENSING, OIL DISCHARGES, MARYLAND, HARBORS,
0077 WATER QUALITY; HYDROCARBONS, ANALYTICAL TECHNIQUES, CONTAMINANTS, *AIR QUALITY,
0163 WATER QUALITY; SEDIMENTS, SEAWATER, HYDROCARBONS, DISPOSAL, *ORGANIC WASTES, CHEMICAL
ANALYSIS, FRESHWATER,
0207 WATER QUALITY; WASTEWATER TREATMENT, REGULATIONS, INDUSTRIES, *OIL POLLUTION, *SEWAGE,
0250 WATER QUALITY; POLLUTION CONTROL, OIL INDUSTRY, *ON-LINE INSTRUMENTATION,
0269 WATER QUALITY; PHYTOPLANKTON, HYDROCARBONS, BIOLOGICAL EFFECTS, ZOOPLANKTON, BENTHOS,
GASOLINE, *MARINE ENGINE EMISSIONS,
0312 WATER QUALITY; OIL SPILLS, ENVIRONMENTAL EFFECTS, ARCTIC, CANADA,
0324 WATER QUALITY; TOXICITY, SEAWATER, HYDROCARBONS, BIODEGRADATION, ESTUARIES,
FRESHWATER, *U.S. EPA,
0361 WATER QUALITY; TAR SANDS, PRODUCTION, CONTAMINATION, CANADA, *ATHABASCA OIL SANDS,
0601 WATER QUALITY; HYDROCARBONS, GROUNDWATER, DISPERSIONS,
0303 WEATHERING; SEDIMENTATION, OIL SLICKS, HYDROCARBONS, FATE,
0366 WEATHERING; TAR, SPREADING, OIL SLICKS, BEHAVIOR, EVAPORATION,
0503 WEATHERING; OCEANS, FATE, CRUDE OIL, EVAPORATION, BIODEGRADATION,
0374 YEASTS; METABOLISM, HYDROCARBONS, BIODEGRADATION, FUNGI,
0169 YUGOSLAVIA; WASTEWATER TREATMENT, SLUDGE, REFINERIES, INCINERATION,
0269 ZOOPLANKTON; WATER QUALITY, PHYTOPLANKTON, HYDROCARBONS, BIOLOGICAL EFFECTS, BENTHOS,
GASOLINE, *MARINE ENGINE EMISSIONS,
0278 ZOOPLANKTON; TOXICITY, METABOLISM, HYDROCARBONS, BIOLOGICAL EFFECTS,
0604 ZOOPLANKTON; PHYTOPLANKTON, METABOLISM, INVERTEBRATES, HYDROCARBONS, FATE, FISHES,

AUTHOR INDEX

ADACHI, M. [illegible]
[illegible]
ANDERSON, [illegible]
ANDERSON, [illegible]
ANDERSON, [illegible]
ANDERSON, [illegible]
ARMITAGE, [illegible]
ARTHUR D. LITTLE, INC. [illegible]
[illegible]
BATTERBEE, [illegible]
[illegible]
BEAL, [illegible]
BEAN, [illegible]
BEAN, [illegible]
BEAN, [illegible]
BEAN, [illegible]
BECCALI, [illegible]
BECKER, [illegible]
BEERBOWER, A. [illegible]
BENT, [illegible]
BENEDETTI, [illegible]
[illegible]
BENSON, A.A. [illegible]
BERTINE, [illegible]
BHAMBI, [illegible]
BHARGAVA, [illegible]
BIGELOW, [illegible]
BISHOP, [illegible]
BISSELL, [illegible]
BISWANGER, [illegible]
BLUM, [illegible]
BLUMS, [illegible]
[illegible]
BOATING INDUSTRY ASSN [illegible]
BOCARD, C. [illegible]
BOCARD, C. [illegible]
BOE, [illegible]
BOELSING, F. [illegible]
BOHNKE, [illegible]
BONNEFORD, F. [illegible]
[illegible]
BOURNE, [illegible]
BOURNE, [illegible]
BOURNE, [illegible]
BRADLEY, [illegible]
BRADLEY, [illegible]
[illegible]
BROWN, [illegible]
BROWNFIELD, [illegible]
BROWNFIELD, [illegible]
BRUNNER, [illegible]
[illegible]
BUCKLEY, [illegible]
[illegible]
BURNS, [illegible]
[illegible]
BURCHARDT, [illegible]
BUTLER, [illegible]
[illegible]
CANADA [illegible] INLAND WATERS [illegible]
[illegible]
CAVAGNARO, [illegible]
CAVAGNARO, [illegible]
[illegible]
CHARTERED INSURANCE INST [illegible]
[illegible]
CHEMICAL INSTITUTE-CANADA [illegible]
[illegible]
CHILLINGARIAN, [illegible]
[illegible]
CHURCHILL, [illegible]
[illegible]
CLARK, [illegible]
CLARK, [illegible]
CONDON, J.A. [illegible]
CONROY, [illegible]
COLEMAN, [illegible]
COLWELL, [illegible]
COLWELL, [illegible]
COLWELL, [illegible]
COLWELL, [illegible]
COMBA, [illegible]
COOPER, [illegible]
[illegible]
CORNER, [illegible]
[illegible]
CRAME, [illegible]
CRETNEY, [illegible]
[illegible]
CRISAFULLI, A.J. [illegible]
[illegible]
CURRY, [illegible]
DALTON CO., LTD [illegible]
DAN VU QUANG [illegible]
DAVIDSON, J.W. [illegible]
DAVIES, [illegible]
DAVIS, [illegible]
DAWSON, [illegible], III. [illegible]
DE ANGELIS, [illegible]
DE [illegible]
DEPT-ENVIRONMENT, LONDON [illegible]
DEPT-ENVIRONMENT, LONDON [illegible]

[illegible]
ENGINEERING INST. CANADA [illegible]
[illegible]
EXXON CORPORATION [illegible]
[illegible]
FOOD-AGRICULTURE ORG, ROME [illegible]
[illegible]

[illegible]
HILDEBRANDT, A. [illegible]
[illegible]
HORNIG, A.W. [illegible]
HORNIG, A.W. [illegible]
HORNIG, A.W. [illegible]
HORNIG, A.W. [illegible]
[illegible]
IDEMITSU KOSAN CO, LTD 0118
IMCO [illegible]
IMPERIAL CHEMICAL IND, LTD 0176

ISHMAEL, J.T. 0133
ITO, H. 0176
ITZKAN, I. 0060
IVANOVA, L.G. [illegible]
IWATA, A. [illegible]
IWAZAKI, H. 0176
JAFFRAS, J.R. 0087
JAUPERT, F. [illegible]
JAMES, R.C. 0061
JAMESON, V.W. [illegible]
JENKINS, C. [illegible]
JENKINS, J.F. [illegible]
JENSEN, P.A. [illegible]
JIANG, L.C. [illegible]
JOHNSON, M. [illegible]
JOHNSON, M. [illegible]
JONAS, A.R. 0082
JONES, L.W. [illegible]
JORANTO, [illegible] [illegible]
JOSHI, A.C. [illegible]
KACZYNSKI, V.W. 0272
KACZYNSKI, V.W. [illegible]
KAKUDA, Y. [illegible]
KARKI, A. [illegible]
KAWAHARA, F.K. 0085
KAWASE, Y. [illegible]
KAWASE, Y. 0220
KAWASE, Y. 0221
KEIZER, F.D. 0068
KENNY, J.E. [illegible]
KETCHUM, B.H. 0315
KIESSER, S.L. [illegible]
KIESSER, S.L. [illegible]
KILBURN, P.D. 0353
KILPATRICK, J.E. [illegible]
KINABE, T. 0091
KISELEV, V.A. [illegible]
KITA, S. 0181
KITA, S. 0182
KITAKOGA, H. 0091
KLEIN, R. 0282
KLEMAS, V. 0067
KLEMAS, V. [illegible]
KNEPEL, H.C. [illegible]
KOBAYASHI, I. 0310
KOGAN, Y.G. 0109
KOLOBANOVA, V.A. 0121
KONO, T. 0181
KONO, T. 0182
KOONS, C.B. [illegible]
KORDAKOV, I.A. 0183
KORETSKII, A.F. 0121
KORRINGA, P. 0316
KU[illegible], L.V. 0177
KUEHNHOLD, W.W. 0283
KUEHNEN, F.L. 0184
KUNG, R.T.V. 0050
LAIRD, D.W. 0327
LANGE, F. 0402
LANOTTE, V.K. 0185
LAROE, E.T. 0327
LAROSE, F.H. 0079
LEE, H.L. 0079
LEE, R.F. 0284
LEE, R.F. 0404
LEFFER, E.M. 0017
LEGATSKI, H.W. 0353
LEGGETT, D.C. 0153
LEONARD, P.F. 0058
LE PETIT, J. 0380
LE PETIT, L. 0386
LE ROUX, I.H. 0076
LEWIS, E.L. 0355
LITTAU, L.W. 0029
LOCKWOOD, A.P.M. 0285
LOGAN, W.J. 0114
LOGAN, W.J. [illegible]
LOUISIANA STATE UNIVERSITY 0287
LOVE, A.H. [illegible]
MACK, W.N. [illegible]
MACKIE, P.R. [illegible]
[illegible], J.F. [illegible]
MAKI, F. [illegible]
[illegible], A.L. [illegible]
[illegible], G.J. [illegible]
MANSBACH, A. [illegible]
MARROW, H.L. [illegible]
MAC [illegible], J. [illegible]
MACE, T.A. [illegible]
MACE, T.J. [illegible]
MAC EWEN, J. [illegible]
MANSFIELD, P.H. [illegible]
MARTY, J.C. [illegible]
MASRIE, A.F. [illegible]
MATSUI, H. [illegible]
MATTIE, W.T. [illegible]
MATTSON, J.S. [illegible]
MAY, W.E. [illegible]
MAYO, D. [illegible]
MC DANIEL, F.W. [illegible]
MC DONALD, J.F. [illegible]
MC ERLEAN, A. [illegible]
MC GILL, A.P. [illegible]
MC KENNA, E.J. [illegible]
MC KENZIE, P. [illegible]
MC KNIGHT, M.S. [illegible]
MEIKLE, E.M. [illegible]
MENTE, C. [illegible]
MERCKEL, C. [illegible]
MERTENS, F.W. [illegible]
MERTENS, E.W. [illegible]
MEYERS, O.P. [illegible]
MEYERS, O.P. [illegible]
MEYERS, E.P. [illegible]
MICOL, C.W. [illegible]
MILLER, C.A. [illegible]
MITCHELL, C.T. [illegible]
MONASTERO, F.C. [illegible]
MONY, O.P. [illegible]
MOORE, A.P. [illegible]
MORGAN, A.H. 0117
MORRIS, R.C. [illegible]
MORTOLA, G. [illegible]
MOURLON, J.-C. [illegible]
MUDJIARDJO, H.S. [illegible]
MULLIN, T.C. [illegible]
MURPHY, T.S. [illegible]
MURRMANN, R.P. [illegible]
NAIDU, A.S. [illegible]
NATIONAL ACADEMY-SCIENCES [illegible]
NAT'L FIELD INVEST CENTER [illegible]
NATIONAL WATER WELL ASSN [illegible]
NEFF, J.M. [illegible]
NEFF, J.M. [illegible]
NEILL, T.O. [illegible]
NEGILSKI, D.S. [illegible]
NEUHAUSER, H.L. [illegible]
N'GUYEN, H.H. [illegible]
NODA, M. [illegible]
NOMURA, K. [illegible]
NORTH, W.J. [illegible]
NOVOTNY, M. 0079
NUCOP CORP [illegible]
NUMAYHID [illegible]
OBUKHOVSKAYA, ZH.G. [illegible]
OGINO, F. [illegible]
OKUNO, K. [illegible]
ONUF, C.P. [illegible]
ONUF, C.P. [illegible]
ONUSKA, F.I. [illegible]

[illegible]
PRINCE, T.A. [illegible]
[illegible]
RESOURCE PLANNING ASSOCIATES [illegible]
RESOURCE PLANNING ASSOCIATES [illegible]
[illegible]
ROBERTS, A.A. [illegible]
ROBERTSON, I. [illegible]
ROBERTSON, R.G. [illegible]
ROGERS, [illegible]
ROSENBERG, [illegible]
[illegible]
RYAN, [illegible]
[illegible]
SANER, W.A. [illegible]
SANER, W.A. [illegible]
SANTNER, J.P. [illegible]
[illegible]
SCRUDATO, R.J. [illegible]
[illegible]

[illegible]
U.S. DEPT OF TRADE [illegible]

U.S. DEPT-ENVIRONMENT	[illegible]
U.S. EPA	[illegible]
U.S. EPA	[illegible]
U.S. EPA	[illegible]
U.S. EPA	[illegible]
U.S. EPA	[illegible]
U.S. EPA	[illegible]
U.S. FEDERAL ENERGY ADM	[illegible]
U.S. FEDERAL ENERGY ADM	[illegible]
U.S. FEDERAL ENERGY ADM	[illegible]
U.S. FEDERAL ENERGY ADM	[illegible]
U.S. GEOLOGICAL SURVEY	[illegible]
[illegible]	[illegible]
VANDERHORST, J.R.	[illegible]
VANDERHORST, J.R.	[illegible]
VANDERHORST, J.R.	[illegible]
VANDERHORST, J.R.	[illegible]
VANDERHORST, J.R.	[illegible]
[illegible]	[illegible]
VANDERMEULEN, J.H.	[illegible]
VANDERMEULEN, J.C.	[illegible]
VANDERMEULEN, J.H.	[illegible]
VANDY, A.	[illegible]
VAN KUILENBURG, J.	[illegible]
VERMEER, [illegible]	[illegible]
VERMEER, [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
VON [illegible]	[illegible]
WAKABAYASHI, Y.	[illegible]
WALKER, J.D.	[illegible]
WALKER, J.D.	[illegible]
WALKER, J.D.	[illegible]
WALTERS, H.C., JR.	[illegible]
WARREN, D.R.	[illegible]
WASIK, S.	[illegible]
WATSON, [illegible]	[illegible]
[illegible], JR.	[illegible]
WEINTRAUB, H.D.	[illegible]
WEINTRAUB, H.H.	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
WERNER, [illegible]	[illegible]
[illegible]	[illegible]
WHELAN, T. III	[illegible]
WHITTLE, K.J.	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
WILKINSON, P.	[illegible]
WILKINSON, P.	[illegible]
WILKINSON, P.	[illegible]
WILKINSON, P.	[illegible]
WILKINSON, P.	[illegible]
[illegible], A.W.	[illegible]
WONG, C.S.	[illegible]
WOODWARD-CLYDE CONSULTANTS	[illegible]
[illegible]	[illegible]
YAMAGUCHI, T.	[illegible]
[illegible]	[illegible]
YEN, T.F.	[illegible]
[illegible], L.V.	[illegible]
YOUNG, L.	[illegible]
[illegible]	[illegible]
ZACHARIAS, E.M.	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

APPENDIX

Periodicals Reviewed

Abstracts on Health Effects of Environmental Pollutants
Alaska Seas and Coasts
Alternatives: Perspectives on Society and Environment
Ambio
American Fisheries Society Transactions
Applied Energy
Applied Microbiology
Applied Science & Technology Index
Aquatic Sciences & Fisheries Abstracts
Audubon
Australian Science Index
Berichte der Deutschen Wissenschaftlichen Kommission fuer Meeresforschung
Biological Abstracts
Bioscience
British Birds
Bulletin of Environmental Contamination and Toxicology
California Water Pollution Control Association Bulletin
Chemical Abstracts
Chemical and Engineering News
Chemical Engineering
Chemical Engineering Progress
Chemical Week
Chemistry in Canada
Chemosphere
Current Contents: Life Sciences
Current Contents: Physical and Chemical Sciences
Deep-Sea Research
Ecolibrium
Ecological Abstracts
Ecological Modelling
Ecological Society of America Bulletin
Ecology Law Quarterly
Energy Review
Environment
Environment Abstracts
Environmental Action
Environmental Conservation
Environmental Geology
Environmental Health and Pollution Control
Environmental Periodicals Bibliography
Environmental Pollution
Environmental Science & Technology
Environmental Technology and Economics
EPA Reports Bibliography Quarterly
Erdoel und Kohle Erdgas Petrochemie vereinigt mit Brennstoffchemie
Estuarine and Coastal Marine Science

Fuel Abstracts and Current Titles
Government Reports Announcements
IMS Newsletter
India Journal of Environmental Health
Industrial Wastes Information Bulletin
International Aerospace Abstracts
International Journal of Ecology and Environmental Science
International Journal of Environmental Analytical Chemistry
International Petroleum Abstracts
Iranian Journal of Science and Technology
Journal of Canadian Petroleum Technology
Journal of Chromatography
Journal of Environmental Science and Health
Journal of Environmental Sciences
Journal of Petroleum Technology
Journal of the Fisheries Research Board of Canada
Journal of Toxicology and Environmental Health
Limnology and Oceanography
Marine Biological Association of the United Kingdom, Journal
Marine Biology
Marine Chemistry
Marine Fisheries Review
Marine Geology
Marine Geotechnology
Marine Newsletter
Marine Pollution Bulletin
Marine Science Contents Tables
Marine Technology Society, Journal
Maritime Research Information Service Abstracts
Massachusetts Audubon
Microbial Ecology
National Fisherman
National Petroleum News
National Research Council, News Report
National Wildlife
Nature
New Technical Books
Nippon Susan Gakkai Shi. Bulletin of the Japanese Society of
Scientific Fisheries
Ocean Engineering
Ocean Industry
Ocean Management
Ocean Oil Weekly Report
Oceanic Abstracts
Oceanus
Offshore
Offshore Abstracts
Oil and Gas Journal
Outdoor California
Pacific Oil World
Petroleum Abstracts
Petroleum Engineer International

Petroleum Today
Pollution Abstracts
Pollution Engineering
Proceedings in Print
Resources
Resource Recovery and Conservation
Royal Society of London, Proceedings, Series B, Biological Sciences
Science
Science News
Science of the Total Environment
Scientific and Technical Aerospace Reports
Sea Frontiers
Sea Secrets
Sea Technology
Selected References on Environmental Quality
Selected Water Resources Abstracts
Sierra Club, San Francisco, Bulletin
Technical Book Review
The Ecologist
The Engineering Index
The International Journal of Environmental Studies
The Sciences
UDS Water Quality Control Digest
Underwater Information Bulletin
Underwater Naturalist
Water, Air, and Soil Pollution
Water Pollution Control
Water Pollution Control Federation, Journal
Water Research
WRC Information
Western Fisheries

U.S. Environmental Protection Agency
Industrial Environmental Research Laboratory
Edison, New Jersey 08817

We are requesting your assistance upon receiving the report ("Oil Spill and Oil Pollution Reports, November 1976 - January 1977").

Is the information usable?
Is the format helpful?

We invite your comments and suggestions. Thank you.

CUT HERE

Name____

Organization___________________________________

Address______________________________________

affix
stamp

Mr. J. S. Dorrler
Industrial Environmental Research Laboratory
U. S. Environmental Protection Agency
Edison, New Jersey 08817

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA-600/2-77-075

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
OIL SPILL AND OIL POLLUTION REPORTS
November 1976 - January 1977

5. REPORT DATE
April 1977 issuing date

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Penelope Melvin, Helmut Ehrenspeck, Paul Nordin

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Marine Science Institute
University of California
Santa Barbara, California 93106

10. PROGRAM ELEMENT NO.
1BB041

11. CONTRACT/GRANT NO.
R-803992

12. SPONSORING AGENCY NAME AND ADDRESS
Industrial Environmental Research Laboratory-Cin., OH
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

13. TYPE OF REPORT AND PERIOD COVERED
Quarterly Nov. 76 - Jan. 77

14. SPONSORING AGENCY CODE
EPA/600/12

15. SUPPLEMENTARY NOTES See also EPA-670/2-75-003, PB-240 719; EPA-670/2-75-044, PB 242 54; EPA-670/2-75-059, PB-243 724; EPA-600/2-76-113, PB-250 745; EPA-600/2-76-185, PB-257 086; EPA-600/2-76-215, PB-259 932; and EPA 600/2-76-266.

16. ABSTRACT

The November 1976 - January 1977 Oil Spill and Oil Pollution Reports is the tenth quarterly compilation of oil spill events and oil pollution report summaries. Presented in the report are: (a) summaries of oil spill events; (b) summaries and bibliographic literature citations; (c) summaries of current research projects; and (d) patent summaries. This report is submitted in partial fulfillment of EPA Grant No. R803992 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the Environmental Protection Agency

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Bibliographies *Summaries *Patents *Documents *Research	Oil pollution Oil spill events Oil spill research Oil pollution control Oil pollution patents	13B

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS (This Report) UNCLASSIFIED	21. NO. OF PAGES 306
	20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE A14-A01